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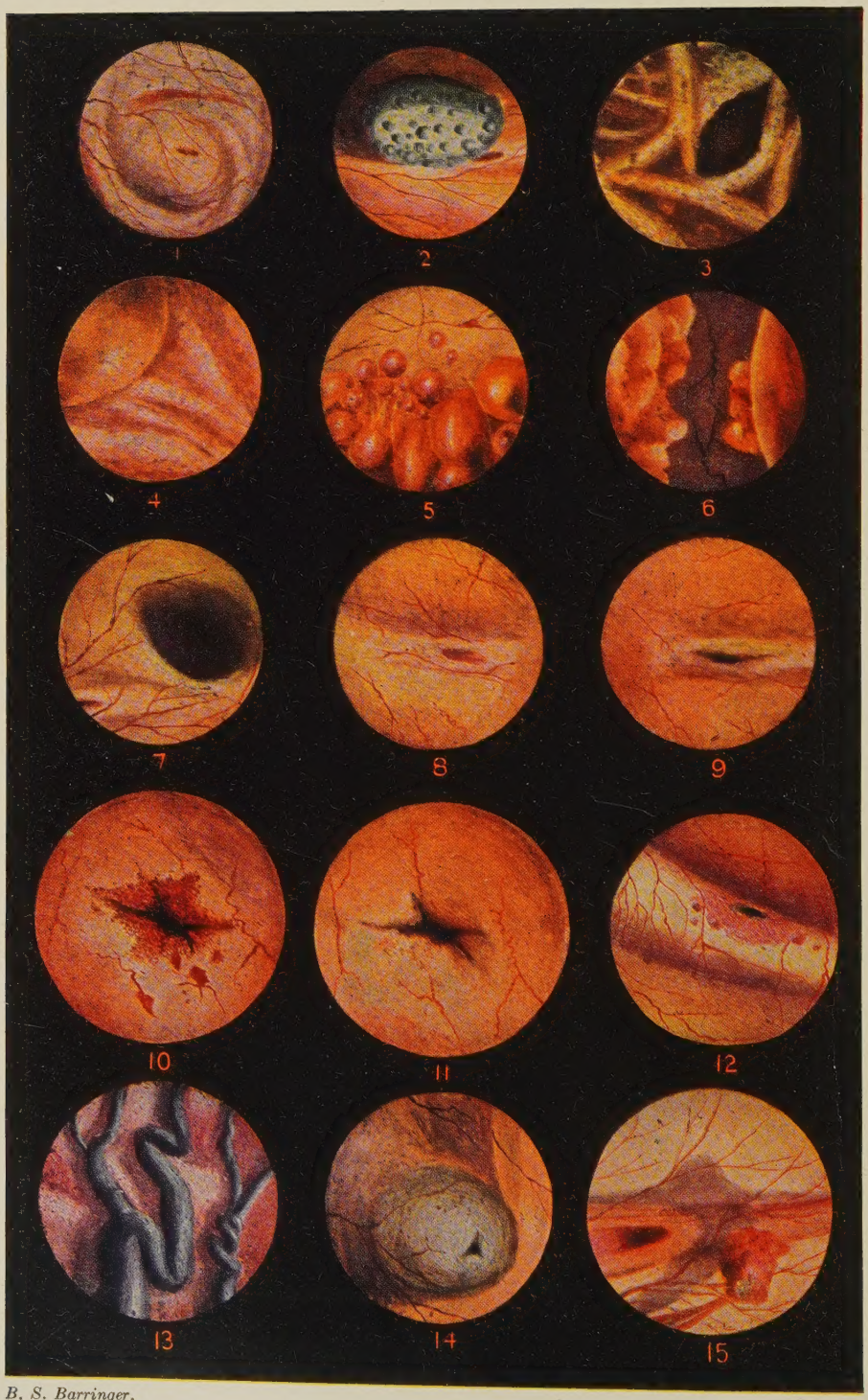
DISEASES OF THE GENITO-URINARY ORGANS



B. S. Barringer.

DISEASES OF THE GENITO-URINARY ORGANS

CONSIDERED FROM A MEDICAL AND SURGICAL STANDPOINT
INCLUDING A DESCRIPTION OF GONORRHEA IN THE
FEMALE AND CONDITIONS PECULIAR TO
THE FEMALE URINARY ORGANS

BY

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SCHOOL; SURGEON TO ST. VINCENT'S HOSPITAL

*WITH ONE HUNDRED AND NINETY-FIVE ILLUSTRATIONS IN THE TEXT
AND SEVEN PLATES, FOUR OF WHICH ARE COLORED*

NEW YORK AND LONDON
D. APPLETON AND COMPANY
1913

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THE SURGICAL DISEASES OF THE GENITO-URINARY ORGANS
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PRINTED AT THE APPLETON PRESS
NEW YORK, U. S. A.

TO

MY BELOVED FATHER

THIS BOOK IS AFFECTIONATELY

DEDICATED

PREFACE

This volume is intended primarily for the use of the student and the general practitioner; it is hoped that from it he may learn how far his own knowledge should carry him in the diagnosis and treatment of diseases of the genito-urinary tract, and in how far he must depend upon the more special training of the urologist, expert in the use of such instruments of precision as the cystoscope and the ureter catheter. A serious effort is made to treat these refinements of urology in detail, though in all the newer branches of the art each specialist develops his own peculiar technic, which cannot, of course, be fully described in a text-book.

The subjects treated in this volume include the diseases of the urinary organs, both male and female, the diseases of the male genital organs, and syphilis. They are considered from the medical as well as from the surgical standpoint.

Text-books on genito-urinary diseases have hitherto followed the anatomical order in the discussion of topics, making, perhaps, exception in favor of Gonorrhea and Tuberculosis. But recent advances in diagnosis, especially by the ureter catheter and the X-ray, have so consolidated the clinical and pathological features of certain other conditions—notably Inflammations of the Upper Urinary Tract and Stone—that these, too, demand treatment apart. Thus the anatomical arrangement is utterly disrupted, and, for the urinary organs, at least, we gladly throw over that sequence with its stilted procession from Anomalies, Injuries, and Inflammations to Stone, Tubercle, and Neoplasm, for a plan that attempts to lead the student from what might be termed the Principles of Urology to Gonorrhea and Prostatism, the great causes of urinary inflammation, and thence to Inflammation, Stone, Tubercle, and the various phenomena related to Hydronephrosis. Chapters upon Neoplasm, Injuries, Anomalies, and other minor topics, close the section on Urology proper. Diseases of the Genitals are treated perforce in

anatomical order. A brief *résumé* of Syphilis follows, demanded by the current methods of collegiate teaching. Last comes the section on Operative Surgery, almost by way of appendix.

It is hoped that both student and practitioner will find that this arrangement makes for lucidity and conciseness, avoiding undue repetition and advancing as far as possible from the general to the particular.

In preparing a work of this size the author has perforce to lean upon many authorities, of which the most noteworthy are the "Handbuch für Urologie," the recently published work of Watson and Cunningham, and the publications of Albarran and his associates.

Acknowledgment of personal service we gladly grant with more precise detail. From my dear father is truly derived, in every sense, the bone and sinew of this work. To my associate, Dr. Chetwood, are to be attributed improvements in technic too numerous to mention. Dr. B. S. Barringer, besides assisting in many minor ways, has written two chapters on Cystoscopy and illustrated them most adequately, both in line and color. Many other drawings throughout the work are from his pen. Dr. E. D. Barringer has expressed the woman's point of view in her two chapters on Gonorrhea in the Female. Dr. T. S. van Riempst has kindly assisted in the collation of authorities.

Edward L. Keyes, Jr.

109 East 34th Street.

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DISEASES OF THE GENITO-URINARY ORGANS

CHAPTER I

PHYSICAL EXAMINATION

The physical examination of a patient cannot be too thorough: errors in diagnosis are more often due to incomplete or careless physical examination than to any other fault. I know several patients with palpably inflamed and enlarged kidneys who have been treated for years for an imaginary cystitis. Twice I have seen prostatectomy done for pyelonephritis. Once I have seen a testis removed for syphilis and twice for subacute epididymitis, the diagnosis of tuberculosis having been erroneously made in each instance. Several patients suffering from arteriosclerotic nocturnal polyuria have been referred to me for prostatectomy. I know of a patient who submitted for months to vigorous local treatment for a mild gleet while he was dying of chronic nephritis.

Such gross errors are due to careless physical examinations. Yet it would be hard to decide precisely what constitutes a complete and careful examination. It is certainly unnecessary, for example, to palpate the kidneys of every patient with gonorrhea; yet it is eminently essential for some of them.

The expert diagnostician shows his skill not only by basing his diagnosis on the few salient points in the history and physical examination, but also and above all by recognizing the doubtful cases and exhausting for them every means of diagnosis at his command.

The general rule of physical diagnosis should therefore be this: Examine the patient to obtain a thorough knowledge not only of the disease from which he suffers but also of all possible complications and concomitant maladies that may have a bearing upon the prognosis or the treatment of this disease.

Disease of the urinary organs is peculiarly prone to be complex. That a patient has prostatitis is no evidence that he has not pyelonephritis. That he has a stone in his bladder does not prove that he has not another in his ureter. That he has a tubercular prostate does not

guarantee him against renal tuberculosis. These are but gross examples of the fact that we must be constantly on our guard against complex conditions in the genito-urinary tract of which the more obvious lesion may be the less important.

The detail of our physical examination should cover several fields, viz.:

General Physical Examination.
Urinalysis.
External Examination of the Genito-Urinary Tract.
Internal Examination.

GENERAL PHYSICAL EXAMINATION

Though by no means always essential, yet it is never a waste of time to note the age, the weight, and the circulatory, pulmonary, and digestive conditions of every patient. That such observation is most important may be demonstrated by the following list of conditions in which data concerning the vital functions are essential:

The condition of the circulation must be carefully studied in every renal case. It is especially important in tuberculosis (p. 461).

The condition of the lungs is preëminently important in tuberculosis and in operative cases.

The condition of the digestion is perhaps the most important of all. It affects the prognosis of even so local a malady as gonorrhea. It determines the dosage of sandalwood oil as well as of hexamethylenamin. It enters into the diagnosis of retention of urine. It is almost everything in certain forms of urinary toxemia.

Study of such important factors is therefore not time wasted. Yet the detail of such study is no special province of ours: it belongs to general medicine.

URINALYSIS

Urinalysis, too, belongs to general medicine. Yet certain features of it are of such special importance in disease of the genito-urinary organs that they merit detailed consideration in Chapter II.

EXTERNAL EXAMINATION OF THE GENITO-URINARY TRACT

We may consider—

Palpation of the kidneys and ureters.
Palpation and percussion of the bladder.
Rectal palpation of the prostate and seminal vesicles, etc.
Palpation of the penis and urethra.
Palpation of the testis and vas deferens.

Palpation of the Kidneys

Position of the Patient.—The patient, with back and abdomen bared, lies upon his back with his knees drawn up and his hands at his sides, so as to relax the abdominal wall as much as possible.

If examination in this position proves unsatisfactory the patient may be turned upon the side opposite to that which is being examined. Lying thus with knees well drawn up, the kidney is sometimes more palpable; but, as a rule, this is not the case.

Palpation of the abdomen with the patient erect but bending slightly forward may reveal renal mobility that otherwise escapes observation. But many patients cannot relax the abdominal muscles while in this position, which is therefore but little employed.

Position of the Examiner.—The examiner sits or stands next to the side to be examined.

The Operation.—If the kidney is very large its outlines may be determined by abdominal palpation. Yet it is almost always necessary, in order to avoid mistakes, to employ *lumbo-abdominal palpation.*

Lumbo-abdominal palpation is performed as follows: To examine the *right* kidney the patient lies, as above described, at the edge of a couch, beside which, and to the right of the patient, the examiner sits. With the index and middle fingers of the *left* hand the examiner now identifies and makes pressure upon the triangular depressible spot below the last rib and just at the edge of the thick spinal muscles. The *right* hand is then placed on the antero-lateral abdominal wall (about an inch external to the linea semilunaris) with fingers directed upward, and their tips just below the free border of the ribs (or of the liver if this be enlarged). This hand is pressed down as firmly as possible, taking advantage of the relaxation of the parietes between inspirations.

With the hands thus placed the examiner may or may not feel a mass between them. In either event he gives a quick, sharp tap to the loin with the fingers of the left hand. The result of this is twofold, viz.:

I. It may elicit *costo-vertebral tenderness.* An area of tenderness confined to the region just below the ribs and beside the spine is almost conclusive evidence of inflammation in or about the kidney. I have never known myositis to produce tenderness in this region.

II. It may elicit *renal ballottement.* This is the sensation, comparable to fetal ballottement, imparted to the fingers depressing the anterior parietes when a sharp tap from behind throws an intra-abdominal body against them.

Ballottement should be attempted first during normal respiration, then with the patient breathing deeply, just as the abdominal wall relaxes at the end of the inspiratory effort.

Renal ballottement discloses the presence of a movable mass in the

loin. It does not prove that mass to be a kidney, nor, if kidney it be, that the organ is diseased. I have obtained ballottement from a mass of tubercular glands and from a neoplasm of the liver.

Yet as a clinical sign ballottement is most useful. When the kidney is normal in size and position ballottement can be obtained only if the patient is very thin and the abdomen very lax. But when the organ is abnormal in size or mobility and this abnormality is but slight, or when examination is impeded by fat or rigidity, ballottement may be the only clinical evidence of this change.

Thus ballottement of the kidney reveals slight enlargement or mobility, though other signs must be depended upon to prove that the mass felt actually is kidney.

In many instances the mass, while large enough to be felt very distinctly by ballottement, escapes every other method of lumbo-abdominal palpation except the following: The patient is instructed to take repeated deep breaths, and as he does so the examiner gradually insinuates the fingers of his right hand deeper and deeper under the ribs, until, at a propitious moment of post-inspiratory relaxation, rather sudden and sustained bimanual pressure distinctly catches the lower pole of the kidney before it slips back under the ribs.

Considerable enlargement or mobility of the kidney is better studied by simple bimanual palpation. The mass is readily felt between the hand on the loin and the hand on the abdomen, and palpation and percussion are employed to outline its shape, size, and mobility.

Differential Diagnosis by Palpation.—Palpation of the kidney scarcely ever affords evidence as to the exact nature of the disease in the kidney. Nephroptosis is diagnosed by palpation (p. 495), and a tender kidney may be said to be an inflamed kidney. Perirenal exudates are sometimes characteristically diffuse. But with these exceptions palpation usually reveals little more that the fact that a mass in the loin probably is or is not of renal origin. Retroperitoneal and adrenal growths cannot be distinguished from renal enlargement by palpation.

The enlarged kidney usually forms an ovoidal movable mass, rising and falling with respiration, palpable by lumbo-abdominal palpation or ballottement. Such a mass if in large part concealed under the ribs is surely renal. But when the kidney is greatly enlarged, or displaced and enlarged, it may be a delicate matter to distinguish the resultant tumor from enlargement of liver, gall-bladder, spleen, or pancreas. The kidney is more lateral in position than any of these organs and more distinctly palpable by lumbo-abdominal palpation. Moreover, a movable kidney may usually be distinguished from a distended gall-bladder by its radius of mobility. The kidney swings back into the loin, the gall-bladder swings to and fro below the liver.

Insufflation of the colon [1] may be of use in differential diagnosis.

On the right side the hepatic flexure covers only the lower pole of the kidney, but is adherent thereto (by the nephrocolic ligament of Longyear). Hence if the kidney is greatly enlarged it carries the hepatic flexure forward in front of it, covering its lower extremity. Most other growths reach the abdominal wall distinctly above and to the inner side of the angle of the colon (e. g., gall-bladder, pancreas, pylorus), but enlargement of the right lobe of the liver descends external to and in front of it. Thus the only tumor whose lower end is likely to be covered by the hepatic flexure of the colon is a renal tumor.

On the left side the transverse colon crosses in front of the lower third of the kidney and the descending colon lies external to it. But the lack of any definite attachment between the two organs permits the enlarged kidney to slip out from behind the colon, and comes to lie to its outer side. When the left kidney is sufficiently large to reach the abdominal wall no hollow viscus intervenes. The descending colon borders the inner side of the mass. Enlargements of the spleen, on the other hand, reach the abdominal wall above the transverse colon.

Palpation of the Ureters

The ureters lie upon the posterior abdominal parietes. Their course may be divided into an abdominal and a pelvic portion.

In the Abdomen.—The course of the ureter through the abdomen begins near the outer edge of the psoas magnus muscle opposite the third lumbar vertebra. Thence it runs on the anterior surface of this muscle downward and a little inward to pass over the brim of the pelvis near the bifurcation of the common iliac artery. At their entrance into the pelvis the ureters are about 5 cm. apart.

The normal ureter cannot be palpated through the abdominal wall. Even when considerably enlarged it can only be felt if the parietes be thin and relaxed. Points of inflammation in its course may be identified as points of tenderness. But palpation cannot distinguish tenderness in the ureter from tenderness due to other causes. On the right side an inflamed ureter is likely to be mistaken for cholecystitis or appendicitis.

In the Pelvis.—The ureters follow the lateral walls of the pelvis in a wide curve whose convexity is outward and backward. As they enter the bladder they are about 4 cm. apart (though the vesical orifices are separated by but 2 cm.).

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[1] The apparatus for this operation is a long rectal tube and the bulb of a Paquelin cautery (or an inverted Vichy bottle).

Through the greater part of their pelvic course the ureters are totally impalpable. Just as they enter the bladder they become palpable in the vaginal vault of the female, in the anterior wall of the rectum in the male. In this location the inflamed ureter may sometimes be felt by bimanual (abdomino-vaginal) palpation in the female. It cannot be felt by abdomino-rectal examination in the male unless very greatly enlarged.

Vaginal Palpation.—The ureter passes behind and below the uterine artery at a point from 0.5 to 1.5 cm. lateral to the uterine cervix. Thence its direction is downward, forward, and inward (almost transversely), against and adherent to the anterior vaginal cul-de-sac, to enter the bladder at a point about 2 cm. from the middle line at the junction of the upper and middle third of the vagina.

Hence the sensitive or enlarged ureter may be palpated for over 2 cm. of its course as it runs transversely across the anterior vaginal cul-de-sac. As it reaches the lateral cul-de-sac it is so far distant from the vagina (usually about 1.5 cm.) as to be inaccessible unless greatly enlarged.

Rectal Palpation.—A large ureteral stone impacted at the entrance of the ureter into the male bladder may be felt by rectal palpation. It may be sought at a point about 1 cm. above the prostate and just internal to the seminal vesicle.

Palpation and Percussion of the Bladder

The bladder may be examined by abdominal palpation and percussion by rectal palpation, and by recto-abdominal bimanual palpation.

Abdominal Palpation and Percussion.—The bladder when empty or partially filled can neither be felt nor percussed through the abdominal wall. The bladder of an infant, lying high in the pelvis, must contain at least 150 c.c. before it can be percussed. The bladder of an adult must contain 300 c.c. or more. To be palpable it must contain about 1,000 c.c.

Percussion of the distended bladder gives a flat note over an area above the pubic bone, the dimensions of which depend upon the distention of the bladder. This area may extend but an inch or two above the pubes or it may rise up to or even above the umbilicus.

Palpation is only possible when the bladder is distended at least half way to the umbilicus. The viscus is felt as a tense sphere rising from the pelvis.

When the bladder reaches the umbilicus and the abdominal walls are lax the tumor in the hypogastrium may be distinctly visible.

Rectal and bimanual palpation are described in the following section.

Rectal Palpation of the Prostate and Seminal Vesicles

The prostate and, in most instances, the seminal vesicles may be felt by a finger introduced into the rectum.

Preparation of the Examiner.—The examiner may protect his finger by a simple lubrication or by a rubber glove or a specially constructed rubber shield. The first is inefficient, the others are unnecessary.

The best protector for the finger is a rubber finger cot (a new one for each examination) and a shield for the rest of the hand, made either by winding a gauze bandage about the finger or by tearing a hole in the midst of a small square of absorbent cotton. The finger cot must be lubricated.

In his other hand the examiner holds a piece of gauze with which to wipe the grease from the patient's anus after the examination.

Preparation of the Patient.—The patient's bladder should be moderately distended, preferably with boric-acid solution. This is to be urinated out after the examination.

Position of the Patient.—Some prefer that the patient should be upon his back with his knees drawn up, others that he should assume the knee-chest position, others that he should bend over a table with his heels apart, his toes turned in, his knees slightly bent, his back "swayed."

Most patients can be effectively examined in the position last described. With his left hand upon the patient's left shoulder the examiner may exert counter-pressure to drive his finger as far as possible up the rectum. The examiner may steady his right hand by bracing the elbow against his right knee.

The Examination.—As the index finger is introduced with its sensitive pulp forward toward the anterior rectal wall, it slips through the two sphincters and enters the rectal cavity above.

Examination of Membranous Urethra and Perineal Body.—With the index finger hooked down and the thumb on the patient's perineum an examination of this body may be made for indurations (Cowperitis, peri-urethritis). Just above this the finger in the rectum feels the membranous urethra, an almost imperceptible cord about 2 cm. long, in the median line. Boggy, lumpy, or tender infiltrations may perhaps be felt about it.

Examination of the Prostate.—As the membranous urethra is followed up the bowel it disappears within the apex of the prostate, which is felt beneath the anterior rectal wall.

The normal prostate as felt from the rectum is heart-shaped, with its apex joining the membranous urethra, its base more or less notched in the center, its lateral lobes quite elastic, its central groove between the two lobes more or less marked.

The normal prostate does not project into the rectum. Its lateral lobes are flat rather than bulging. Its outline is a little vague. In order to examine it carefully the finger must be swept over its surface and around its borders. Great experience is required to recognize a normal prostate. So varied are the degrees of sensitiveness, and of prominence of the organ, so frequently do we find phleboliths or enlarged glands lying upon it or near it, that the specialist is frequently compelled to confess that he can find nothing abnormal in a prostate that has been pronounced diseased by a less experienced examiner.

The chief signs of a normal prostate are:

The lobes are flaccid, flat, insensitive.

An exquisitely sensitive prostate (like an exquisitely sensitive urethra) may be anatomically normal. A sensitive and tense prostate usually contains pus. A prostate with rounded, tense insensitive lobes is usually hypertrophied, but may be simply inflamed. The relative roundness of the lobes is appreciated by sweeping the finger across them from side to side.

A prostate may be inflamed or hypertrophied and yet feel normal to rectal touch.

There are no indurations in or about the prostate.

Discrete round masses on or near the prostate are usually glands or phleboliths. Indurations within the lateral lobes or projecting toward the seminal vesicles are usually inflammatory; they may be tuberculous or neoplastic. Indurations extending from one or both lateral lobes into the base of the bladder beyond are invariably neoplastic.

Examination of the Vesicles.—The distinction between the seminal vesicle and the ampulla of the vas is not possible by rectal touch. If the perineum is deep or the prostate hypertrophied it may be impossible to insert the finger far enough up the rectum to reach the vesicle.

The normal seminal vesicle is impalpable.

The dilated or inflamed seminal vesicle is felt as an irregular, elongated mass beginning just above the prostate, laterally, and extending upward or upward and outward beyond the reach of the finger. If greatly enlarged the vesicles may meet in the middle line, but usually there is a space about a finger's breadth in width between them. The inflamed vesicle feels doughy or doughy and lumpy.

Examination of the vesicles may sometimes be made easier by counter-pressure on the hypogastrium.

A vesicle may be inflamed and yet feel normal to rectal touch.

Examination of the Base of the Bladder.—Neoplasms of the bladder and large stones in the lower end of the ureter may sometimes be felt by rectal touch in the space between the vesicles. Counter-pressure on the abdomen is of assistance in this examination.

Abdomino-rectal palpation sometimes reveals stones in the bladder, but in this respect the examination is likely to be extremely misleading.

Palpation of the Penis and Urethra

Palpation of the Penis.—This presents no peculiar difficulty other than that of identifying obscure circumscribed fibroses in the corpora cavernosa.

Palpation of the Urethra.—The urethra should be palpated upon a sound just large enough to fill it without distention. Careful palpation upon this reveals even the smallest infiltrations in and about the urethral wall.

Only the anterior urethra can be palpated externally. The membranous urethra must be palpated from the rectum. The prostatic urethra can scarcely be palpated.

Palpation of the Testicles and Vas Deferens

Palpation of the Testicle.—The testicle should be palpated by slipping it to and fro between the thumb and the index finger. The chief characteristics to be noted are its size and tension as compared with its fellow, the condition of the epididymis, the presence of hydrocele, and of pathologic conditions in and about the testicle.

The normal epididymis must be carefully palpated many times before the examiner's fingers attain complete familiarity with its usual variations in size, consistence, and attachment to the testicle. Thereafter the location of indurations in the seminal gland may be located without difficulty.

The presence of hydrocele is often a confusing element in diagnosis. Here again familiarity with the tension of a normal testicle and with the groove that separates it from the epididymis makes the alteration of that tension and the obliteration of that groove by hydrocele immediately recognizable.

Palpation of the Vas Deferens.—The physician should also accustom his fingers to follow the vas from its origin at the tail of the epididymis up to and into the inguinal canal, in order to recognize changes in its size or sensitiveness.

INTERNAL EXAMINATION

The technic of passing urethral instruments and of using the urethroscope, the cystoscope, and the ureter catheter is taken up in the following chapters.

CHAPTER II

URINALYSIS

The foundation of urology is urinalysis. Without a thorough practical familiarity with this art as practiced in the laboratory and in the clinic, no man may expect to diagnose diseases of the urinary organs.

The practice of urinalysis is twofold: Laboratory Urinalysis and Clinical Urinalysis.

LABORATORY URINALYSIS

In the laboratory the urine is subjected to tests for acidity, specific gravity, albumin, sugar, indican, etc.; it is centrifuged and the cellular, crystalline, and bacterial content of the sediment noted.

Such an analysis every physician must be competent to perform. There is no special need, therefore, to dwell upon it here, except to insist upon certain points of peculiar interest to the urologist.

The Selection of the Specimen.—This is of the greatest importance. Unless the patient's general health and the examination of a single specimen warrant the belief that the kidneys are sound a *twenty-four-hour specimen* should, of course, be examined.

But this is not enough. The urologist is chiefly interested in the bacterial and cellular content of the urine. This he wishes to examine without contamination (if possible) by the secretions of the urethra or of the vagina. Hence *the specimen for microscopical examination must be obtained direct from the bladder.* To accomplish this it is sometimes best to draw the urine by catheter; but usually it is quite sufficient to have the patient urinate into two glasses (as described below) and to examine the contents of the second glass. This precaution is even more useful for the analysis of the urine of women than of men, though this is not generally recognized.[1]

The old-fashioned method of examining the "morning" and "night" specimens of urine has been generally discarded in favor of the "twenty-four-hour" specimen. Yet in estimating the cause of noc-

[1] Such special methods of obtaining urine as suprapubic puncture, ureteral catheterization, etc., do not enter into the present discussion.

turnal frequency of urination, especially in persons past middle age, a comparative quantitative examination of the urine passed between 9 P.M. and 9 A.M. and that passed between 9 A.M. and 9 P.M. is often imperative. Without it one cannot decide whether nocturnal frequency of urination is due to the polyuria of arterial disease or to prostatism or some other local irritant.

Thus a complete laboratory urinalysis consists of—

(1) Chemical and physical examination, qualitative and quantitative, of a "twenty-four-hour" specimen.

(2) Microscopical (and bacteriological) examination of the centrifuged sediment of the bladder urine, obtained by catheter or by the two-glass method.

(3) In certain cases a comparative examination of "night" and "day" urines.

The Analysis.—The tests that suffice for most cases are:

PHYSICAL TESTS—Reaction.
Specific Gravity.

CHEMICAL TESTS—Urea.
Albumin (quantitative).
Sugar (quantitative) (acetone, etc., if sugar is found).
Indican.
Phosphates.

MICROSCOPICAL EXAMINATION—Crystals (differential).
Blood and pus cells.
Epithelial cells (differential).
Bacteria (differential), especially the gonococcus and the bacillus of tuberculosis.

Albumin.—Upon the meaning and importance of the physical and chemical tests we need not dwell, except to insist that the statement so commonly made that "albumin is accounted for by pus" is almost invariably inaccurate, and often fatally misleading. The urine, mixed with about one fifth of its bulk of normal salt solution and then tested for albumin,[1] never shows more than a trace except under three

[1] For qualitative analysis the acetic-and-heat and the nitric-ring tests are the best. The former is the more delicate if properly performed, thus:

(1) The filtered urine (four parts) and salt solution (one part) mixture in a test-tube is held over a Bunsen flame so as to boil only its upper 2 cm.

(2) To this is added, without shaking, one or two drops of acetic acid.

(3) If a cloud of phosphates is thrown down by the boiling and partially redissolved by the acid the test-tube is shaken just enough to dissolve the rest of this.

(4) The mixture is once more boiled.

(5) The upper portion of the fluid is examined by means of a camera obscura.

conditions: (1) Nephritis. (2) Acute prostatis. (3) Profuse hematuria.

So long as there is much blood in the urine, or acute prostatitis, a moderate albuminuria has no great significance, but in the absence of these, and *even in the presence of slight macroscopical hemorrhage or of chronic prostatis, the appearance in the urine of one quarter of one per cent of albumin (by weight) means nephritis, and if there is pyuria, pyelonephritis.* No amount of pus will liberate so much albumin.

The importance of this fact is great, for the gravest cases of pyelonephritis may evoke no symptoms directly referable to the kidney, and may deliver urine in which the few kidney casts are overwhelmed in pus and may be overlooked by even the most painstaking search. In this event the amount of albumin in the urine is the first hint that the kidney is involved.

Epithelial Cells.—The debate as to the ability of the microscopist to identify epithelial cells from the ureter and the renal pelvis has been on for a generation and is still open. The frequent opportunity of examining specimens of urine obtained by the ureteral catheter has of late years educated many men to the point of making this diagnosis with reasonable certainty. A quantity of round and polyhedral cells little larger than a pus cell can only come from the kidney, pelvis, or ureter. A few round, small cells may be desquamated in prostatitis, but these are accompanied by very large round prostatic cells, and usually by squamous bladder cells. Moreover, these prostatic cells may often be eliminated by using the two-glass test or by drawing the urine by catheter.

Accuracy in this diagnosis cannot be learned from a text-book, but must be obtained from a study of specimens obtained by the ureteral catheter.

Bacteria.—A physician whose laboratory equipment is adequate cannot do better than examine all purulent urines by smear and culture for their bacterial content. Yet this is not essential. It is only essential that the clinical urologist understand two things:

(1) Diagnosis of the gonococcus (p. 183), and

(2) Diagnosis of the bacillus of tuberculosis (p. 459).

This step is the most important of all. The camera consists of a small box, black inside, with a vertical slit on one side to admit the light, a round hole in the bottom to admit the test-tube, and a flap fixed like an open cover to conceal the source of light (an incandescent bulb is better than daylight). The light striking the fluid suffuses it and plainly shows against the darkness inside the camera an albuminous cloud that would otherwise elude observation.

CLINICAL URINALYSIS

On the score of common knowledge we have skimped the description of laboratory analysis to make room for detailed description of the special knowledge required for a competent clinical urinalysis, without which the urologist is hopelessly at sea.

Clinical urinalysis consists in looking at the urine and interpreting what we see therein. It suggests the nature and quantity of substances held in suspension in the urine. It suggests, also, in many instances, the part of the urinary tract from which these substances are derived. But *it is by no means infallible, and its findings must always be confirmed by laboratory urinalysis and by physical examination of the patient.*

These propositions are fundamental. They seem to leave a very small place in the diagnosis for this clinical test whose only function is to suggest and not to prove. Yet, practically speaking, clinical urinalysis is employed far more often than the laboratory tests. At the first examination of a case it often—very often—gives the suggestion that leads ultimately to correct diagnosis, and in subsequent examinations it is our chief means of judging the progress of the case.

At the patient's first visit, therefore, the urine should be carefully inspected before it is submitted to laboratory tests, though the inferences made from inspection should not be acted upon unless the laboratory confirms them. At subsequent visits, on the other hand, clinical examination of the urine by inspection is always imperative, while laboratory examination is only required from time to time.

Technic of Clinical Urinalysis.—It is by no means a waste of time to describe precisely what is meant by "looking at the urine." This does not mean looking at it as it lies in the bottom of an opaque vessel; it does not mean looking at it after it has shaken about in a bottle in the patient's pocket for hours; it does not even mean glancing at it casually in a dirty glass and by an imperfect light. What it does mean is this:

Let the patient present himself for examination at least two, and if possible three of four, hours after his last urination. Let him pass into a large, clean tumbler (a pint glass is the best size) about 50 c.c. of his urine, the rest into a second glass.

Let the physician now examine the contents of these two glasses against a strong light.[1] No speck or cloud in them is too insignificant to be noticed. Let the examiner view them intently and begin to draw tentative conclusions, recognizing that these conclusions are not final, but attempting to estimate what he *probably* sees. "This is a foreign

[1] An electric bulb affords the best light. It is brilliant, constant day and night, and may readily be covered by the fluid so that practically all its rays are transmitted through the urine and the examiner's eyes are not dazzled.

body." "This is a shred which, to judge by its size, comes from the anterior urethra. There is a speck of blood adherent to it." "This haze is opalescent, and, therefore, probably crystalline or bacterial." "This other is so slight and granular in appearance that it is probably due to prostatitis." "This blood, evenly distributed through the urine, is probably renal." "This other, with a swirl of fresh blood still undistributed, is more probably vesical or prostatic."

Such are a few of the thousand and one inferences drawn by the expert examiner. By making such inferences categorically in one's mind, and confirming or refuting them in the laboratory or by physical examination, one soon learns to make rapid and accurate inferences from data imperceptible to the inexperienced eye.

The accuracy of these inferences may be increased by:

I. The acetic-acid test.

II. The comparison of the contents of the first and second glass (for men only).

III. Comparison with these of a third glass of urine (for those cases in which the two-glass test might prove misleading).

The Acetic-acid Test.—The substances held in suspension in the urine are organic and crystalline. The former (pus, blood, bacteria, etc.) form the object of the clinical examination, while the latter (crystals), though of considerable importance in the general diagnosis, are only confusing here. Their presence simply obscures the undissolved organic content of the urine.

Now of the various crystals that may cloud the urine, the earthy phosphates are the commonest and the most important. *Urates* and *uric acid* are rarely seen in any quantity in freshly passed urine (and their reddish color distinguish them), *oxalates* or *cystin* scarcely ever occur in such quantity as to cloud the urine,[1] but the phosphates are common and readily soluble by acidulation of the urine.

Therefore, if examination of the urine in two glasses shows that both are cloudy (for the phosphatic cloud, since it originates in the kidney, appears in both urines[2]) the glass containing the second urine is held

[1] I have several times seen an oxalate cloud, once a cystin cloud. They produce the same opalescent haze as do phosphates or bacteria, and are distinguishable only by the microscope.

[2] When the phosphates are in great excess they are not distributed evenly throughout the urine but, having settled in the bladder, are most concentrated in the last drops. In extreme phosphaturia this concentration of crystals in the last drops is so marked that the patient can occasionally squeeze from the urethra little gritty masses of phosphates left there after urination is complete.

The characteristics of this *phosphaturia*, as it is called, are the following: It occurs almost exclusively in youth, between the age of fifteen and thirty-five. It is apparently due to a functional disturbance in assimilation, and is therefore commonly seen in young persons who work with their heads rather than with their hands, is often associated

against the light and a few drops of acetic acid poured down its side. If phosphates are present, there is instant effervescence (from the breaking up of carbonates that are always associated with phosphates) and clearing of the urine.

This clearing may be interfered with in only two ways, viz.: By the presence in the urine of insoluble substances (crystalline or organized), the nature of which must be determined by microscopic analysis, and by the presence of copaiba in the urine: the urine of a phosphaturic patient taking copaiba clears only for an instant, and then becomes cloudy again, the copaibal cloud being only a little less opalescent than the phosphatic cloud which it replaces.

When, therefore, we know from previous microscopic analysis the nature of the insoluble substances in a patient's urine, and know, also, that he is not taking copaiba, the acetic acid test is used as the simplest method of removing a chance phosphatic cloud as a routine preliminary to the clinical examination of the urine.

Comparison of the First and Second Urines.—Having tested for phosphates by the addition of a few drops of acetic acid, and dissolved these, if present, by adding an excess of this acid, the physician holds the two glasses into which the patient has passed his urine against the light and compares their contents.[1]

The first urine passed is the urine as it lay in the bladder, plus what it has swept from the urethral walls (and vagina in the female).

The second urine passed is the urine as it lay in the bladder, without admixture of anything gathered from the urethra during its exit.[2]

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with functional dyspepsia, and like this is most marked at periods of mental stress. It never causes stone or inflammation of the urinary passages, and its association with pus in the urine is purely accidental. Its chief clinical characteristic is its sudden appearance and disappearance; at one micturition the urine is milky with phosphates, at the next absolutely sparkling and clear. Its prognosis is good; it gradually lessens with age; it does no harm. The sexual neurasthenic of course looks upon it with horror, and for the mental relief of such persons treatment of the phosphaturia is required.

First, one should insist that the phosphaturia is harmless in itself and only a sign of functional derangement. Secondly, one must insist upon a strict régime of diet and exercise appropriate to the existing nervous or digestive disturbance. Thirdly, one must remember that a direct attack upon the phosphaturia by drugs is usually a failure, and if successful is only of temporary efficacy. Hexamethylenamin, salol, benzoate of soda, and other urinary acidifiers have a reputation beyond their merits. Ten drops of dilute hydrochloric acid before each meal I have found more efficacious than anything else, but our main reliance is hygiene, especially as to diet and exercise.

[1] Comparative examination of the two urines is of no interest if the patient is a woman since the differences in them are chiefly accounted for by the vaginal secretion in the first glass. It is scarcely necessary to add that examination of a third glass is equally inapplicable to women.

[2] This elementary physical fact that the first fluid flushes the outlet and the second comes clean from the tank would scarcely require explanation were it not for the fact that so many physicians believe that the first urine passed shows the contents of the

This rule has but two exceptions, as follows: If the insoluble substances suspended in the bladder urine are very dense they may settle to the bottom as the urine lies in the bladder and come away chiefly with the last drops of urine. The substances which fall within this exception are blood-clots, crystals (usually phosphates), and pus, when present in great quantity (such as usually comes from a severe pyelonephritis).

The second urine may also be contaminated by whatever may be squeezed from the urethral wall during the "piston stroke" muscular spasm that clears the urethra of the last drops of urine. Under this exception come pus squeezed from the prostatic ducts (or from a prostatic abscess) when the prostate is gravely inflamed, and blood squeezed from the bladder neck (or from the adjoining surface of bladder or urethra) when this is acutely inflamed, ulcerated, or the seat of neoplasm.

These exceptions amount clinically to this:

The two-glass test may mislead in the presence of hematuria or of active suppuration in prostate or kidney.

The Three-glass Test.—For such cases a still further hint (none of these tests are proofs) as to the conditions present may be obtained by making the patient pass his urine in three glasses instead of two without interrupting the flow of urine in transferring from one glass to another. The three specimens thus obtained represent:

I. Bladder urine (less sediment), plus washings of urethra.

II. Bladder urine (less sediment).

III. Bladder urine, plus sediment or substances expressed by "piston stroke."

Yet this test is very rarely employed, since its disclosures are confusing (failure to determine the derivation of the contents of the third glass), and require verification by other methods of examining prostate, bladder, and kidneys, which methods are themselves far more accurate than this three-glass test.

Another three-glass test frequently employed as an aid in the diag-

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anterior urethra, the second those of the posterior urethra. This fundamental error is fostered by the clinical fact that the contents of the posterior urethra are often mingled with those of the bladder before urination. In this event the first urine passed contains what it sweeps from anterior and posterior urethra during the urination, plus what has entered the bladder from the posterior urethra between urinations, while the second urine contains only what has flowed back into the bladder from the posterior urethra, between urinations (supposing the bladder and kidneys add no contamination). Thus the comparison of the two urines may under certain conditions show one the content of the anterior urethra, plus that of the posterior urethra, the second only that of the posterior urethra, and under these special conditions the first urine does roughly represent the anterior urethral washings, the second urethra the posterior. But to step from this particular to a broad generalization is inaccurate and misleading both in theory and in practice.

nosis of chronic prostatitis or vesiculitis is the following: The patient urinates into two glasses, but retains some urine in the bladder. The physician then massages the prostate or the vesicles (or both), and the patient then passes into a third glass the *remaining* urine, carrying with it the expressed *secretion* from the glands massaged.

This test is accurate only in case the second urine is quite clear, and is necessary only when it is impossible to squeeze from the suspected gland enough secretion to make it appear at the meatus, and when the instrumentation necessary to fill the bladder with a clean solution before massage is impracticable.

On the whole, therefore, these three-glass tests are little used.

The Five-glass Test.—A variety of tests involving the use of a greater number of glasses have been devised for the specific purpose of locating inflammation in the anterior or posterior urethra exclusively. But inasmuch as such tests help to distinguish the origin of pus in the urine, they sometimes form an important part of clinical urinalysis.

The best [1] of these tests is Kollmann's. It is based upon the fact that the anterior urethra may be washed fairly (though not always absolutely) clean by a stream of fluid flowing from a soft-rubber catheter [2] introduced down to the bulbous urethra. The tank from which the fluid flows must be less than three feet above the urethra, otherwise some of the fluid may penetrate the deep urethra and vitiate the test.

The test is performed as follows:

I. The anterior urethra is irrigated with sterile salt solution through the catheter until this portion of the urethra is believed to be clean. The fluid from this wash constitutes the contents of the first glass.

II. This wash is continued into the second glass. Its clearness proves that the anterior urethra has been washed clean.

III. The first urine passed by the patient now contains the bladder urine contaminated only from the posterior urethra or the kidney; this is the third glass.

IV. The fourth glass contains a second portion of the urine precisely like the previous (third glass) one, except that its contamination from the posterior urethra is less by the amount swept from the canal by the first urine passed, and consists, in fact, of only what may have flowed back into the bladder between urinations.

V. The fifth glass, containing the last urine passed, is the same as

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[1] Young, Johns Hopkins Hospital Reports, vol. xiii, p. 1. This author has devised a seven-glass test. He irrigates the pendulous urethra anterior to the suspensory ligament, then the bulbous urethra, hoping thereby to differentiate mild chronic inflammations of these two parts of the anterior urethra. But in view of the relative inaccuracy of all these tests this one, depending for its accuracy on the theory that pus will not run uphill in a collapsed tube, is scarcely practical.

[2] Goldenberg prefers a hard-rubber tube, Letzel a metal, Young a glass one.

the fourth, plus any pus or shreds squeezed from the posterior urethra by the "piston stroke" at the end of urination, and any thick (probably renal) pus that may have settled in the bladder.

The inferences to be drawn from the five-glass test are, therefore, the following:

Anterior urethritis gives pus or shreds in I.

Posterior urethritis gives pus or shreds in III, in III and V, or in III, IV, and V. If in all three, the contamination is greatest in III, or in III and V.

Cystitis gives pus in III, IV and V, evenly distributed. Pus from the ureter or kidney is evenly distributed through III, IV, V, or densest in V.

Actually this test is rarely employed except in connection with other tests to distinguish between chronic anterior and posterior urethritis when the bladder and kidneys are known to be normal.

The Essence of Clinical Urinalysis.—The results to be expected from any of these methods of clinical urinalysis are directly proportionate to the skill of the examiner. The essence of the test is his ability to distinguish at a glance slight variations in the amount of pus, blood, or shreds present. Thus clinical urinalysis is of the greatest use for the prognosis from day to day. As a diagnostic test of the nature of disease it is at its weakest.

CHAPTER III

URETHRAL INSTRUMENTS: THEIR ASEPSIS

URETHRAL INSTRUMENTS

The axiom that a good workman does not complain of his tools implies in him appreciation and possession of adequate instruments. The urologist, therefore, must thoroughly understand the nature, the care, and the use of urethral instruments.

In the selection of urethral instruments no two authorities can be expected to agree. Thus the specialist can afford to employ many instruments which would be useless in less familiar hands. But certain instruments are required by every man wishing to do good urological work. All of these we believe to be included in the following list. It may be enlarged according to the fancy of the physician; it can scarcely be diminished.

Such instruments as are useful but not necessary are put in brackets.

A set of conical sounds. (No. 15 to 32 French.)

A set of olivary-tipped conical woven bougies. (No. 10 to 20 French.)

A set of bulbous bougies. (No. 10 to 30 French.)

Kollmann dilators.

Filiform bougies.

[A set of tunneled steel sounds and filiforms.]

[A set of Janet steel sounds and filiforms.]

Soft-rubber catheters. (No. 15 to 20 French.)

[Woven olivary catheters.] [Woven elbowed catheters.]

Woven double elbowed catheters. Woven olivary elbowed catheters.

[Soft-rubber elbowed catheters.]

[Indwelling catheters.]

An elbowed obturator.

Urethroscopes and attachments.

Cystoscopes, ureteral catheters, etc.

[A urine segregator.]

Silver catheters.

Tunneled or guided catheters.

[Silver prostatic catheters.]

Stone searcher.

A 200 c.c. syringe.
Urethral injection syringes.
An instillator. (Keyes or Guyon type.)
Nozzles and apparatus for anterior urethral irrigation.
[A Chetwood urethral clip.]

Scales.—The scale for grading the caliber of urethral instruments was first accurately fixed in France, where two scales are at present in use—the Charrière (commonly known as the French scale) and the Béniqué. Other scales are the English and the American.

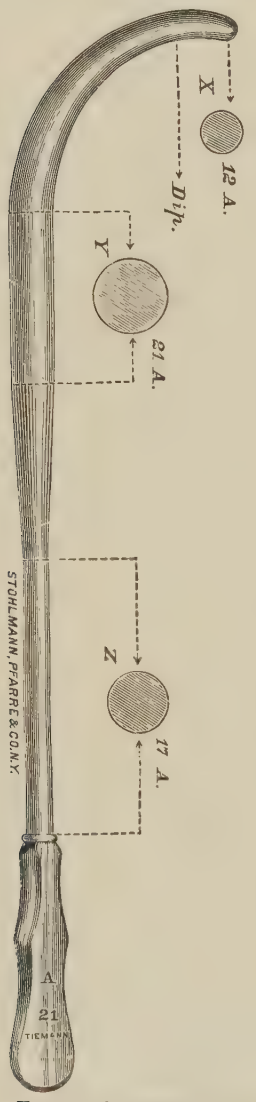

Fig. 1.—Double Taper Sound.

Of late years the tendency in this country, as well as in England, has been to adopt the French scale as the most convenient, while in France itself there is a tendency to replace the old French (Charrière) by the new Béniqué scale. Although Dr. Van Buren, senior author of the parent edition of this work, was very tenacious of the American scale—which, indeed, was born in his office—the almost universal adoption of the French scale since his time has led us to drop the American in favor of the French scale.

The French (Charrière) scale indicates diameters in $\frac{1}{3}$ mm. No. 1 has a diameter of $\frac{1}{3}$ mm., No. 2 a diameter of $\frac{2}{3}$ mm., and so on. From this scale, therefore, the diameter of an instrument may be determined by dividing its number by 3. A No. 30 sound has a diameter of 30 mm. $\div 3 = 10$ mm.

The Béniqué scale indicates diameters in $\frac{1}{6}$ mm. It numbers instruments twice as high, therefore, as the Charrière. A No. 30 French sound is a No. 60 Béniqué. B. = F. $\times$ 2.

The American scale indicates diameters in $\frac{1}{2}$ mm. Thus its numbers are $\frac{2}{3}$ as high as the French. 30. F. = 60 B = 20 A. A. = F. $(1 - \frac{1}{3}) = \frac{2}{3}$ F.

The English scale follows no rule, but its numbers are generally about 2 less than the American. Thus, 30 F. = 60 B. = 20 A. = 18 E. E = (A. or $\frac{2}{3}$ F.) — 2.

Sounds and Bougies.—A metal instrument for urethral exploration is commonly

termed a *sound* (though a bulbous bougie may be metallic), while a flexible instrument (made of woven silk and varnished) is called a bougie.

The best woven instruments are made in France.

Conical sounds are employed for dilatation. Sounds are made in this country of nickeled steel. Those made in Europe of nickeled copper do not rust and are therefore preferable.

In order to spare the patient's meatus, I have all my sounds above 24 F. size made with double taper (Fig. 1).

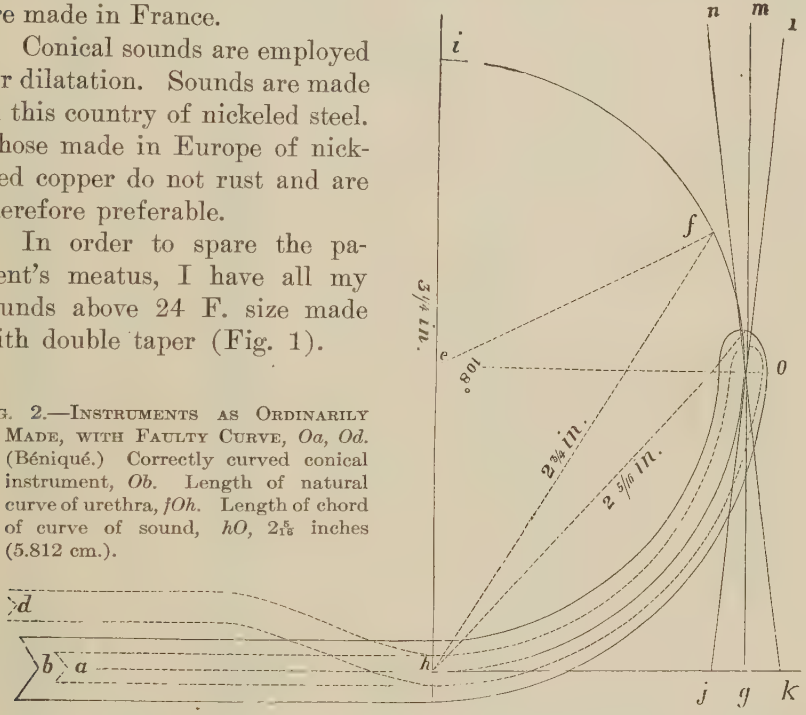

FIG. 2.—INSTRUMENTS AS ORDINARILY MADE, WITH FAULTY CURVE, *Oa*, *Od*. (Béniqué.) Correctly curved conical instrument, *Ob*. Length of natural curve of urethra, *fOh*. Length of chord of curve of sound, *hO*, 2 5/16 inches (5.812 cm.).

American custom favors the use of the single-curve sound (Fig. 2), while European custom favors the double-curve or Béniqué instru-

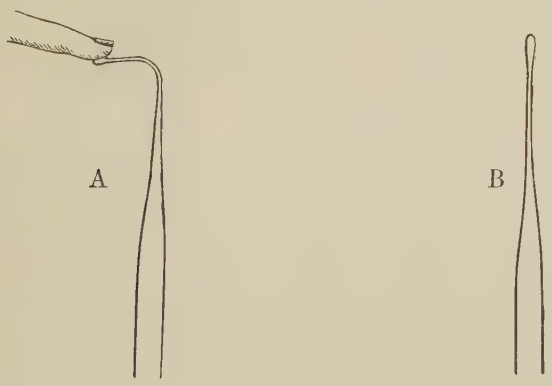

FIG. 3.—OLIVARY BOUGIES.

ment (Fig. 2). After many years' use of the former, I have discarded them in favor of the latter.

Conical woven bougies (Fig. 3) should be olivary tipped. Inasmuch as they are used to dilate strictures up to the point where steel sounds may be used, one should possess a complete set from 10 to 20 French size. The neck of the instrument should be quite flexible, as suggested in Fig. 3 A.

Bulbous bougies (Fig. 4) may be flexible or metallic. The best French makes of flexible bougies are almost as durable as and more useful than the metallic instruments.

Kollmann dilators (Fig. 5) are useful for dilating the urethra while sparing the patient the insignificant operation of meatotomy, and also to carry dilatation to great lengths. The Oberlaender, Frank, and Thompson dilators are inferior to the Kollmann.

Fig. 4.—Bulbous Bougie.

The best models of these dilators are made of pure nickel by Gentile in Paris. The nickel does not rust, and the instrument may therefore be sterilized by boiling.

This dilator is made in several designs, some of which have irrigating attachments. The two types illustrated are the ones generally employed. Dilators are so much more painful than sounds to certain patients that they can never fully supplant them.

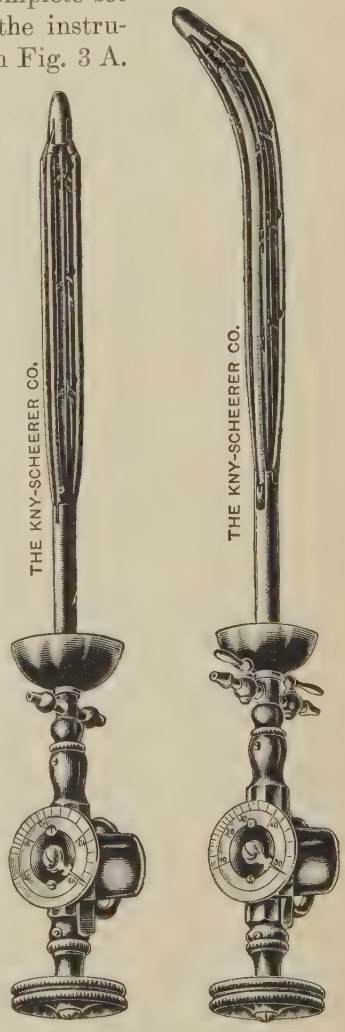

Fig. 5.—Kollmann Dilators.

Fig. 6. — Filiform Bougies.

Filiform bougies (Fig. 6) are made of whalebone or of woven silk. Their average size is 3 French; they should be olive tipped. The choice between whalebone and woven filiforms is largely a matter of taste. Both are fragile, liable to break off in the urethra, and therefore *old, frayed, and ragged filiforms should be instantly discarded.*

Inasmuch as filiforms are used chiefly as pathfinders for larger instruments, the choice of filiforms depends largely upon the in-

struments which are to follow. Three combinations are possible, viz.: the whalebone filiform and the tunneled sound (Fig. 7), the French woven filiform and the Janet sound (Fig. 8), the Banks bougie (Fig. 9).

Fig. 7.—Whalebone Filiform and Tunneled Sound.

Fig. 8.—Woven Filiform and Janet Sound.

The excellence of our whalebone instruments, and the difficulty of obtaining satisfactory woven filiforms, has made the whalebone-tunneled-sound combination the popular one in this country, in spite of its mechanical inferiority.[1]

[1] The rough eye of the tunneled sound scratches the urethra, slips with difficulty over the filiform, and bends or even breaks this in the urethra, complicating the already difficult situation by the addition of a false passage or a foreign body.

The combination of a good woven filiform and a Janet sound (a set of these should contain at least every alternate number from 10 to

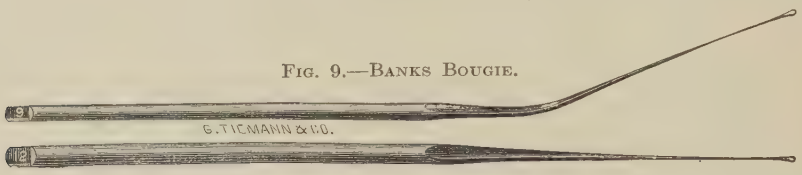

Fig. 9.—Banks Bougie.

20 French) is better, both because of its smoothness and because the filiform may be tied into the urethra until, by repeated dilatations, a sufficient size shall have been attained to insure the patency of the stricture. For almost every emergency, however, the Banks bougie, a filiform whalebone instrument, suddenly enlarging to 10 or 12, French size, is the best of all.

Catheters.—A good catheter must be smooth both inside and out, boilable and durable. Two special features of importance are the "round-edged" or "velvet" eye, now universally employed, and the funnel end, which is universally employed in Europe and conspicuously neglected by American manufacturers.

Soft-rubber catheters commend themselves for general use by their flexibility. Of all urethral instruments they can be passed the most gently. The choice of sizes lies between 15 and 20 French. An instrument larger than the latter size is unnecessary, while

Fig. 10.—Olivary Catheter.

Fig. 11.—Elbowed Catheter.

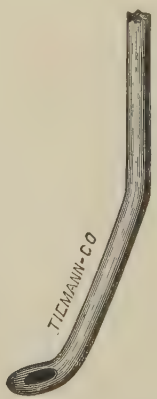

Fig. 12.—Double-elbowed Catheter.

Fig. 13.—Olive-tipped Catheter.

most instruments of the former size have so small a caliber that they transmit fluids very slowly, and are obstructed by even a small amount

of viscid pus or blood-clot. Yet these smaller instruments pass more comfortably through a sensitive urethra.

Woven olivary catheters (Fig. 10) are useful to penetrate a small orifice (stricture, spasm), *while woven elbowed catheters* (Fig. 11), introduced with the point directed upward, ride over obstacles on the urethral floor (false passage, hypertrophied prostate). *Woven double-elbowed catheters* (Fig. 12) ride over certain prostatic obstacles which the single-elbowed instruments will not surmount. *Woven olive-tipped elbowed catheters* (Fig. 13) combine the advantages of the olivary and elbowed instruments, and are more generally useful than either. But sometimes a spasmodic or congested urethra admits a blunt instrument more readily than an olive-tipped one, just as occasionally a straight instrument passes where an elbowed one will not. Since woven instruments have a relatively larger caliber than soft-rubber ones, they may be employed in rather smaller size (15 to 17 French), and one should possess very small woven instruments (8 to 10 French) to pass a tight stricture or a greatly congested prostate.

Fig. 14.—Silver Catheter with Long Prostatic Curve. (Thompson.)

Soft-rubber olivary and elbowed catheters and special types of indwelling catheters are not necessary instruments, and since they have to be made of a relatively perishable mixture they are usually stiff and useless before the occasion for their use arises.

Fig. 15.—Guyon Obturator.

For such prostatic obstacles as cannot be surmounted by even the double-elbowed catheter, various ingenious devices have been employed. The *silver catheter*, with a long, "prostatic" curve (Fig. 14), is a dangerous instrument in inexpert hands, which may rarely be passed with safety, even by an expert, more than once or twice in a given case. A very satisfactory substitute is the *elbowed or Béniqué curved obturator* of Guyon (Fig. 15). This, when slipped into a rubber or woven catheter, converts it temporarily into a stiff instrument, with the great advantage that the obturator may be withdrawn, leaving an indwelling, soft catheter in the urethra.

Silver catheters, tunneled or threaded, for filiforms, are useful in an emergency to relieve stricture retention.

The silver catheter curved like a sound, that is found in every pocket case of instruments, is inferior in every respect, except that of portability to a woven instrument.

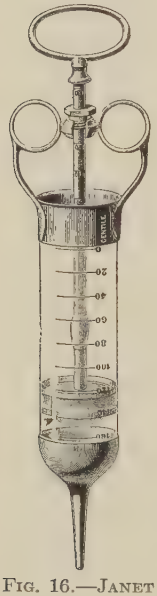

Fig. 16.—Janet Syringe.

Syringes and Nozzles. — One of the most difficult to obtain of all urological instruments is a good syringe of large capacity.

The Janet syringe (Fig. 16) is an excellent instrument, and Heyden's modification of it still better, with the sole exception that its metallic walls do not show dirt (an exception for which its indestructibility makes full amends). These syringes hold 125 to 150 c.c. of fluid. When not in use, the rubber piston must be kept out of the barrel.

Quarter-ounce blunt-nozzled glass syringes are necessary for injections into the anterior urethra.

Instillators of the Keyes [1] pattern (Fig. 17), as at present constructed, consist essentially of small-caliber, short-curve silver catheters, with the eye in the tip. These are fitted with a standard thread to fit any hypodermic syringe. The instruments are thus readily sterilized and portable. The straight part of the shaft should be six inches long, in order to keep its outer end clear of the glans penis.

Anterior Urethral Irrigation.—*The apparatus for anterior urethral irrigation* consists of a tank (preferably of glass, and so hung that it may be readily raised and lowered), a connecting tube, a nozzle, and means of interrupting the flow of fluid through the tube.

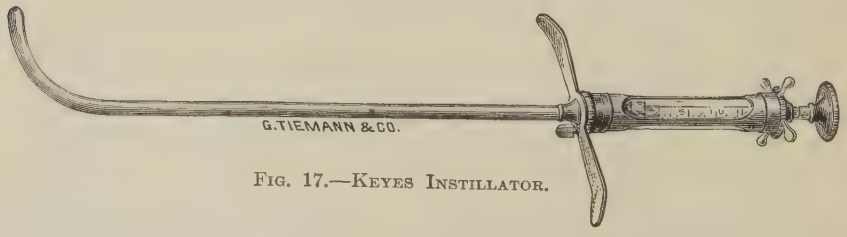

Fig. 17.—Keyes Instillator.

The tank forms part of the urological equipment. Of nozzles and interrupters there is a great variety. The simple, blunt-pointed glass

[1] The Ultzmann syringe, of which the Keyes is a modification, is a very clumsy instrument. The Guyon instillator, a capillary woven catheter, has never found favor in this country. Modifications of the Keyes instrument have been made by Cabot, Bangs, and others.

nozzle and a cut-off with protecting bell, form the most familiar apparatus. We usually employ Chetwood's two-way nozzle and cut-off scissors

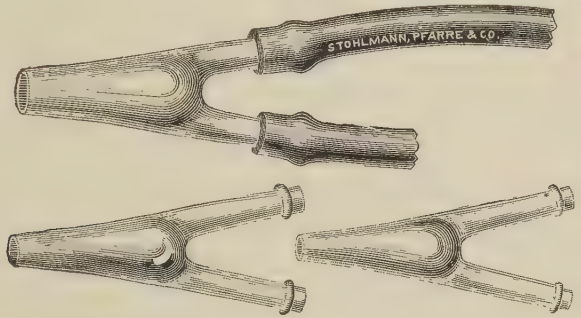

Fig. 18.—Chetwood Nozzles.

(Fig. 18). They are not quite so easy to manipulate, but are far less splashy. The little soft-rubber nozzle of a quarter-ounce glass urethral syringe makes a very convenient tip for forced irrigation of the bladder with a large (Janet) piston syringe.

A very convenient instrument for retaining fluids in the anterior urethra is the Chetwood urethral clip. If properly applied, it completely occludes the meatus without undue pressure, and may be left on quite indefinitely.

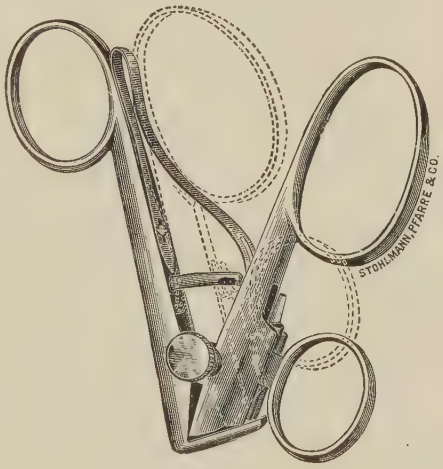

Fig. 19.—Chetwood Scissors.

Urethroscopes, Cystoscopes, Etc.—A description of urethroscopes, cystoscopes, etc., is more appropriately reserved for a special chapter. The same is true of the operative armamentarium.

ASEPSIS IN URETHRAL EXAMINATION

However infected the bladder into which a catheter or sound is to enter, that catheter must be scrupulously aseptic. The days when surgeons may joke about the old gentleman who keeps his catheter inside his hat and spits on it by way of lubrication are past.[1] Even when the

[1] Yet such old gentlemen are still encountered in practice. But the apparent immunity which some of them enjoy is due in part to the fact that their bladders are already so severely infected that a little saliva makes them no worse. And though their

bladder is infected asepsis is imperative, to prevent an increase of that infection.

The asepsis of catheterism, using the term broadly to cover every passage of an instrument into the urethra, implies three requirements, viz.:

1. Asepsis of the physician's hands.
2. Antisepsis of the patient's urethra, and
3. Asepsis of the instrument introduced.

Asepsis of the Physician's Hands.—It is not possible to require of the physician about to pass a catheter that he sterilize his hands as if for a surgical operation, or wear sterile rubber gloves. Such cleanliness is only required for such prolonged and delicate operations as cystoscopy. But the physician's hands should be well washed with soap and water, and, *having washed his hands, the physician should act as though they were still dirty;* i. e., he should not touch that part of the instrument that is to enter the deep urethra. This is a simple rule, a necessary rule, a universal rule. *The last three inches of the instrument should not be touched by anything except sterilized lubricant from the time it is sterilized until it enters the urethra.*

Antisepsis of the Patient's Urethra.—It has been amply proven [1] that, though the posterior urethra is sterile, the normal anterior urethra may harbor quite an indefinite number and variety of pathogenic microörganisms. But, on account of the mechanical cleansing of the urinary stream, these are almost exclusively confined to the balanitic portion of the canal. Yet it is not unusual to find bacteria in the bulb of the uninflamed urethra, though it is most unusual not to find them in the terminal inch. The pathogenic bacterium most frequently identified is the Bacillus coli communis.

Moreover, the preputial cavity swarms with bacteria. Hence has arisen the practice of washing the glans penis and flushing the terminal inch of the urethra with boric acid solution before introducing any instrument. Though such washing and flushing is scarcely more effective than that of the urinary stream, and might, therefore, be omitted, except in case the danger of infection is unusually great; i. e., in cystoscopy, catheterism for aseptic retention, and tying in an indwelling catheter, perfect technic requires that this washing and flushing always precede introduction of urethral instruments of whatever description.

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immunity may long prevail, in the end they become more and more infected and die of sepsis. The need for scrupulous asepsis is not because every dirty catheterism causes infection—far from it—but because a single dirty catheterism *may* cause infection of the gravest sort.

[1] Lustgarten and Mannaberg, *Vierteljahresschrift J. Derm. u. Syph.*, 1887; Rovsing, "Die Blasenentzündungen," 1890; Wassermann and Petit, *Guyon's Annales*, 1891, ix, 371; Melchior, "Cystite et infection urinaire," Paris, 1895.

The Inflamed Urethra.—When the urethra is acutely inflamed, the passage of instruments is permissible only for the cure of that inflammation, or for the relief of retention of urine. In either event the mechanical damage done by any added manipulations outweighs their virtue. No special effort should therefore be made to clean the canal: the glans and meatus should be well washed.

Chronic urethritis is no bar to the passage of instruments. These may be used either for the treatment of urethritis or for the diagnosis or treatment of coexisting conditions.

In the former case the instrumentation (catheterism) habitually carries with it its own antisepsis (injection).

In the latter event (passage of sound, cystoscope, etc.), not only may this instrumentation not directly imply antisepsis, but it may directly imply considerable trauma to an infected canal. Therefore it is necessary to precede the instrumentation by a soap-and-water and bichlorid wash of the glans and adjoining tissues, and a thorough irrigation of the meatus, and even, in some cases, of the whole urethra, with silver nitrate 1:1,000, or oxycyanid of mercury 1:4,000. But the urologist must not confide too much in what is at best but a superficial and incomplete antisepsis of the anterior urethra. The danger of infection is far more closely related to clumsiness or roughness in passing the instrument than to preliminary urethral antisepsis. *Every surgical operation must be cleanly; but every urethral manipulation must also, and above all, be gentle.*

The dangers of urethral instrumentation are local (exacerbation of urethritis, prostatic or periurethral abscess), and chiefly to be avoided by discretion in the choice of and gentleness in the passage of the instrument; or general (urethral chill, systemic gonorrhea, urinary septicemia), and chiefly to be avoided by antisepsis, to a less degree by gentleness.

This antisepsis, of which the principles and practice are discussed in Chapter XXXI, consists in—

Hexamethylenamin before,
Gentleness during, and
Local antisepsis after instrumentation.

The hexamethylenamin may often be omitted with impunity, and, since it implies administration of the drug for forty-eight hours before instrumentation, it is often neglected. But there is no excuse for neglecting to be gentle or for omitting some form of antisepsis after instrumentation. Even when the temper of the urethra is well known the omission of a post-instrumental antisepsis may unexpectedly excite a sharp chill.

The usual post-instrumental antisepsis consists of an instillation of

nitrate of silver or an irrigation with some silver salt or with permanganate of potassium.

Asepsis of the Instrument.—In any case, the instrument introduced must be aseptic. By this we mean that the whole instrument must be rendered aseptic,[1] and must so remain except for its contact with the physician's hands, which, as already stated, should not touch its terminal three inches.

This asepsis implies four conditions:

(1) Aseptic lubrication.
(2) Antisepsis immediately after using.
(3) Aseptic preservation.
(4) Antisepsis before using.

Lubrication.—The lubricant employed for urethral instruments should be soluble in water. Oily lubricants, such as vaselin or olive oil, may be perfectly sterilized by boiling, but they can only be removed from the instrument with great difficulty, if at all. Hence, an instrument covered by an oily lubricant is much more difficult to resterilize than one which is mechanically clean. Albarran has shown that a clean catheter may be sterilized by boiling for ten minutes, while an oily catheter must be boiled half an hour.

Among the substances in common use as lubricants may be mentioned glycerin and boroglycerid. Guyon uses a mixture of equal parts of water, glycerin, and soap powder. Various combinations of Iceland moss, sterilized in formalin, are sold under different trade names. But the best lubricant I know has the following formula, devised by Dr. E. Wood Ruggles:

Dissolve 1 cm. of oxycyanid of mercury in 200 c.c. of hot sterile water; add 35 c.c. of glycerin and water enough to make 350 c.c. Let this mixture cool; then add 10 to 15 gm. of powdered gum tragacanth. Let this stand until it becomes a homogeneous mass, a process which takes several days, but may be hastened by occasional stirring to break up the lumps. The amount of tragacanth employed depends upon the consistence of this substance, which varies considerably.

This lubricant may be put up in sterile paint tubes. Its quality depends upon the employment of precisely the right amount of tragacanth.

The Instrument.—The practice of asepsis for urethral instruments is approximately that of general surgery, and requires that—

(1) The instrument should be so constructed as to be readily cleansed. It should be as free as possible from joints, crannies, etc. It should be in good condition, free from rust or cracks.

[1] The flaming of a metal instrument whereby the beak and shaft are sterilized but the dirty handle remains uncleansed would be perfectly permissible were it not a dangerous habit to permit the least relaxation of asepsis. Moreover, the convenience of flaming compared to boiling is quite imaginary.

(2) It should be sterilized by boiling. Strong (almost saturated) sodium chlorid solution is less destructive than plain water.[1]

(3) It should be washed clean and sterilized immediately after using, kept sterile (if possible), and resterilized immediately before using.

(4) Instruments for use in "pus cases" should be kept entirely distinct from those for use upon "clean cases."

Unfortunately the one instrument that is the least subject to any of these rules, viz., the cystoscope, is the very instrument that preëminently requires sterilization. The special measures required for sterilization of cystoscopes are, therefore, considered elsewhere (p. 51).

All other instruments should be subjected to the following:

(1) Soap and water wash, inside and out, immediately after using. Then rinse in water and boil for at least fifteen minutes in strong salt solution.

(2) Keep the instruments in an instrument case, the interior of which is kept at least relatively clean by formalin (trioxymethylene) pastilles, or a formalin lamp.

(3) Unless the instrument has been recently used and its asepsis assured, always resterilize by boiling for fifteen minutes immediately before using.

(4) Use a separate set of catheters at least for gonorrheal cases. For each absolutely uninfected case I prefer to use a new rubber catheter.

The special variations and precautions in the technic of sterilization required by various instruments are the following:

Sounds.—The Continental nickel-plated copper sound may be readily sterilized by boiling; but the American nickel-plated steel sound rusts. After boiling and before being put away, steel sounds should, therefore, be passed through the Bunsen flame or rubbed down with alcohol and dried.

Dilators and Other Complex Instruments.—Dilators, urethrotomes, and such complex instruments should be made of pure nickel; otherwise it is almost impossible (especially in the case of the Kollmann dilator) to keep them from rusting. If nickel-plated only, they may be sterilized like the cystoscope (p. 51).

Woven Instruments.—It is the accepted tradition that woven instruments cannot be boiled, and it is current practice to sterilize them by formalin vapor. But I have for several years been boiling all my woven instruments, and can assert that they stand boiling perfectly well if they are of standard French manufacture (any one of half a

[1] Krotoszyner (*Medical News*, 1904, lxxxv, 406) makes this suggestion, which I have found useful, and also suggests a saturated solution of ammonium sulphate for woven instruments.

dozen firms) and if their sterilization is surrounded with a few simple precautions.

When a woven instrument is boiled, its varnish becomes utterly soft, and therefore cracks if any other instrument rests upon it, or if it is bent before it has cooled. Therefore, in order to boil such an instrument without destroying it, it must lie perfectly straight in the sterilizer, touching neither the sides nor the ends of this, and with no other instrument resting upon it. More important still, *after the instrument has been boiled it must not be touched* until it has been cooled off, either by lifting it from the water on an automatic platform or by pouring in cold sterilized water.

Simple as these precautions are, it is impossible to make an orderly or nurse observe them. The urologist is obliged to boil his own woven instruments.

Asepsis of Other Instruments and of Solutions

In order to permit clean urethral work, the wall tanks, syringes, and other containers, as well as the solutions, must be sterilized quite as carefully as the urethral instruments themselves.

Tanks, Syringes, Etc.—All containers are best sterilized by boiling immediately before each clinic or office hour. Wall tanks may, however, be left filled with an antiseptic solution between times. It is necessary to have at hand a pan of boric-acid solution in which to cool sounds after boiling, and to rinse instruments that have been sterilized by formalin. It is my custom to keep all syringes, hypodermic needles, mixing rods, instillator catheters in a 10 per cent formalin solution, supersaturated with borax.[1]

It is peculiarly important that all containers should be kept from any contact with urine. The measuring glass for urine should, therefore, be of a peculiar shape, readily distinguishable from that employed for the solutions.

Solutions.—All solutions should be made up fresh, warm, and aseptic. The chemicals are kept in a certain stock (preferably solid) form (p. 202), and the water must be both sterile and warm. The urologist should have two boilers, containing a gallon or two apiece, each one of which should be boiled every alternate day, so that hot and cold sterile water are at hand to be mixed in any desired proportion.

For him who depends upon a central supply of sterilized water (e. g., a boiler in the operating room), the following is a more convenient sys-

[1] Steel instruments do not rust in this solution if enough borax is kept in it actually to supersaturate it and leave a little undissolved at the bottom of the jar. As the borax dissolves very slowly what may appear enough when the solution is first made up proves insufficient a day or two later.

tem: Cold sterile water is kept in a glass reservoir and hot water in a metal reservoir, covered with asbestos.

Summary of Instrumental Asepsis

For Cystoscopes.—Cabinet containing formalin lamp and desiccation apparatus. Clean well before and after sterilization.

For Other Instruments.—Boil for fifteen minutes. Use soluble lubricants, and boil again before sterilization. Keep in formalin cabinet.

For Solutions.—Hot and cold boiled water in boilers or tanks. Containers boiled daily. Mixing rods, syringes, etc., boiled and kept in sterile solutions.

CHAPTER IV

THE PASSAGE OF URETHRAL INSTRUMENTS

The successful introduction of an instrument into the urethra depends upon the skill of the operator and his comprehension of the obstacles that may defeat the operation.

ANATOMY OF THE URETHRA

The urethra is the outlet of the bladder. It commences at the bladder neck, but embryologically and anatomically that part of the floor of the bladder known as the trigone (i. e., the triangular space between the orifices of the ureters and the urethra) belongs to the urethra, and will be so considered.

The urethra tunnels the upper part of the prostate, perforates the triangular ligament, and terminates at the end of the penis. Its outer opening is known as the *meatus,* or the *meatus urinarius.* The urethra is divided naturally into two parts, the *anterior* and the *posterior urethra,* by the triangular ligament, the anterior urethra lying external to the anterior layer of that structure, and the posterior urethra being

Fig. 20.—Sagittal Section through Glans and Fossa Navicularis. (Cruveilhier.)

Fig. 21.—Transverse Section of the Penis. (Cruveilhier.)

the continuation of the canal backward into the bladder. The anterior or spongy portion of the urethra is again subdivided into four parts, the navicular (or the fossa navicularis, Fig. 20), penile (Fig. 21), scrotal, and bulbous or bulbo-perineal. The posterior urethra is subdivided into the membranous, the prostatic, and the trigonal portions. It is much more accurate to speak of a lesion, such as a foreign body or a

stricture, as being at the peno-scrotal angle or in the bulb, than to say it lies at a depth of 4 or 6 inches, for not only does the length of the urethra vary according as the penis is erect or flaccid and in disease (hypertrophy of the prostate), but the urethral length, the urinary distance, varies widely in different healthy individuals (p. 39). The urethra is always a closed canal throughout its whole course, except when distended by some foreign substance.

The *mucous membrane* of the urethra consists of a layer of epithelium, of which the superficial cells are squamous in the navicular and prostatic regions and columnar elsewhere, on a connective-tissue basement substance particularly rich in elastic fibers to allow for the great distensibility of the canal.

The Anterior Urethra.—In the anterior urethra the mucous membrane is surrounded, except in the fossa navicularis, by a very thin longitudinal layer of unstriped muscle fibers (in direct continuity with the inner fibers of the prostate), and these are in turn surrounded by a circular layer of unstriped muscle. These circular fibers are so few around the spongy urethra that their very existence was denied by Sappey. Finally, the anterior urethra is surrounded from triangular ligament to meatus by the corpus spongiosum, except for the half inch nearest the bladder, where the corpus spongiosum fails to cover the roof of the urethra and is enlarged below into the *bulb*.

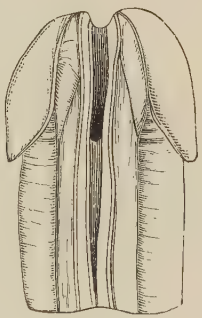

Fig. 22.—Lacuna Magna. (Cruveilhier.)

Crypts and Glands.—In the roof of the fossa navicularis lies the *lacuna magna* (Fig. 22), a simple pocket in the mucous membrane with its orifice toward the meatus, and consequently open to entrap small instruments. This lacuna varies greatly in size in different persons, being sometimes entirely absent, and occasionally running as far back as the triangular ligament, forming the so-called double urethra (*q. v.*). A few other smaller lacunæ lie along the roof of the penile urethra. *The glands of the urethra,*[1] to be distinguished from the lacunæ, are of the compound racemose type, of very small caliber, lined with a cylindrical epithelium. They lie chiefly on the roof of the anterior urethra, and are more numerous in its deeper parts. They are also found on the roof of the membranous urethra. In some instances they pierce the sheath of the corpus spongiosum and extend for some distance within it —an important fact in relation to organic stricture of the canal, since these glands convey the products of urethral inflammation into the corpus spongiosum and so involve it in the subsequent cicatrization.

[1] Paschkis, *Monatsbericht f. Urol.*, 1903, No. 6.

Cowper's glands are two small, round, lobular bodies, each about the size of a cherry stone, lying just behind the bulb of the urethra in the muscle between the layers of the triangular ligament. Their ducts open on the floor of the bulbous urethra.

The color of the membrane is pale pink. In rest its walls are in contact, obliterating the cavity of the canal, so that a cross-section presents a transverse slit instead of an opening (Fig. 21).

The anterior urethra is called the *external urinary tract,* and the canals and reservoirs beyond the *internal urinary tract,* for the anterior urethra is in free communication with the surface of the body and harbors all the microörganisms that may lie thereon. As a general thing it does this with perfect impunity. Its *flora* includes the Bacillus coli communis, pyogenic streptococcus, and staphylococci, and other less noxious bacteria (p. 156). Such bacteria as flourish normally in the anterior urethra, being constantly washed out by the urine, and entering only through the meatus (except under pathological conditions), are more numerous in the fossa navicularis, and the bacillus coli and the pyogenic cocci are usually found only in that region.

The Posterior Urethra.—The posterior urethra, extending from the anterior layer of the triangular ligament to the bladder, presents many notable points of contrast with the anterior urethra. The canal is no longer surrounded by erectile tissue, and, indeed, it could scarcely become erect, for whereas the anterior urethra is freely movable with the penis, the posterior urethra possesses a fixed curve—of which later. Moreover, the posterior urethra is, in its normal state, entirely free from the bacteria harbored by the anterior urethra; it is the lowest section of the aseptic internal urinary tract. The posterior urethra is divided into the membranous and the prostatic urethra, and the trigone of the bladder.

The Membranous Urethra.—Of all parts of the canal the membranous urethra is the most fixed, running, as it does, from the aperture in the anterior layer of the triangular ligament to the aperture in the posterior layer. Its mucous membrane, though of a darker color and much more sensitive, does not differ in structure from that of the anterior urethra. This in turn is surrounded by a thin layer of unstriped muscle, but instead of being sheathed in the corpus spongiosum, it is embedded in the voluntary muscle that fills the space between the two layers of the triangular ligament. This muscle has had special names given to different portions of it by Guthrie, Müller, Wilson, and others, but it may be considered clinically as one muscle, the *constrictor* or *compressor urethræ,* the *cut-off* muscle, the external or voluntary sphincter of the bladder. The last term best expresses its function. It is the muscle by which the outflow of urine from the bladder is voluntarily opposed. If a catheter is introduced through it, no voluntary effort of the in-

dividual is able to arrest the stream of urine. Indeed, inhibition of this muscle is the chief act of the will in voluntary urination. It may, however, suffer from spasm, and so not only prevent urination, but also present a serious obstacle to the introduction of instruments. This is spasmodic stricture (*q. v.*).

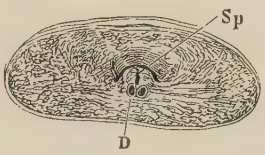

FIG. 23.—TRANSVERSE SECTION OF CENTER OF PROSTATE. *D*, ejaculatory ducts; *Sp*, sinus pocularis. (Cruveilhier.)

The Prostatic Urethra.—The prostatic urethra tunnels the prostate, sometimes barely covered by that organ above, sometimes deeply embedded in it (Fig. 23). It is fixed only where it joins the membranous urethra. It is fusiform in shape, being closed internally by the internal or involuntary sphincter of the bladder. Into it the ducts of the sexual organs empty. It is lined by squamous epithelium like that of the bladder, and is liable to great deformity and obstruction by hypertrophy of the prostate gland. Upon its floor rises a little mass of erectile tissue, the *verumontanum*, or caput

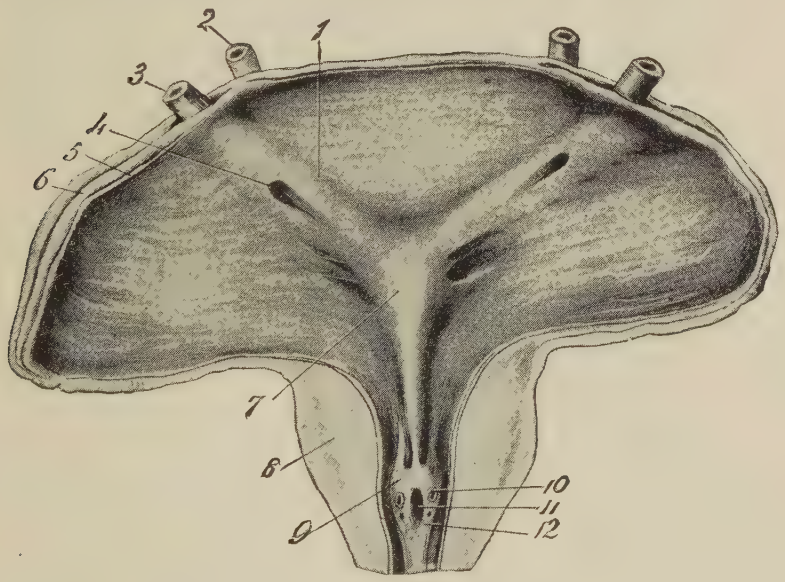

FIG. 24.—LOWER PART OF THE MALE BLADDER, WITH THE BEGINNING OF THE URETHRA. Exposed by incising the anterior wall and laying it open. 3, ureter; 4, opening of the ureter; 2, vas deferens; 9, colliculus seminalis; 7, center of trigone; 8, section of prostate; 10, orifice of the common ejaculatory duct; 11, opening of utricle; 12, mouths of prostatic gland ducts; 1, interureteric fold. (Henle.)

gallinaginis, the anterior slope of which is hollowed out into a little cavity, the *sinus pocularis* (Fig. 24). The prostatic ducts open upon the floor of the urethra on each side of the verumontanum. The ejaculatory ducts usually open in the sinus pocularis or on its edges.

The Sphincteric Mechanism.—The urinary tract, like the intestinal tract, possesses two sphincters, an internal sphincter of unstriped muscle and an external sphincter of striped muscle fiber (Fig. 25).

The external or voluntary sphincter is the constrictor or compressor urethræ, mentioned above. It surrounds the membranous urethra al-

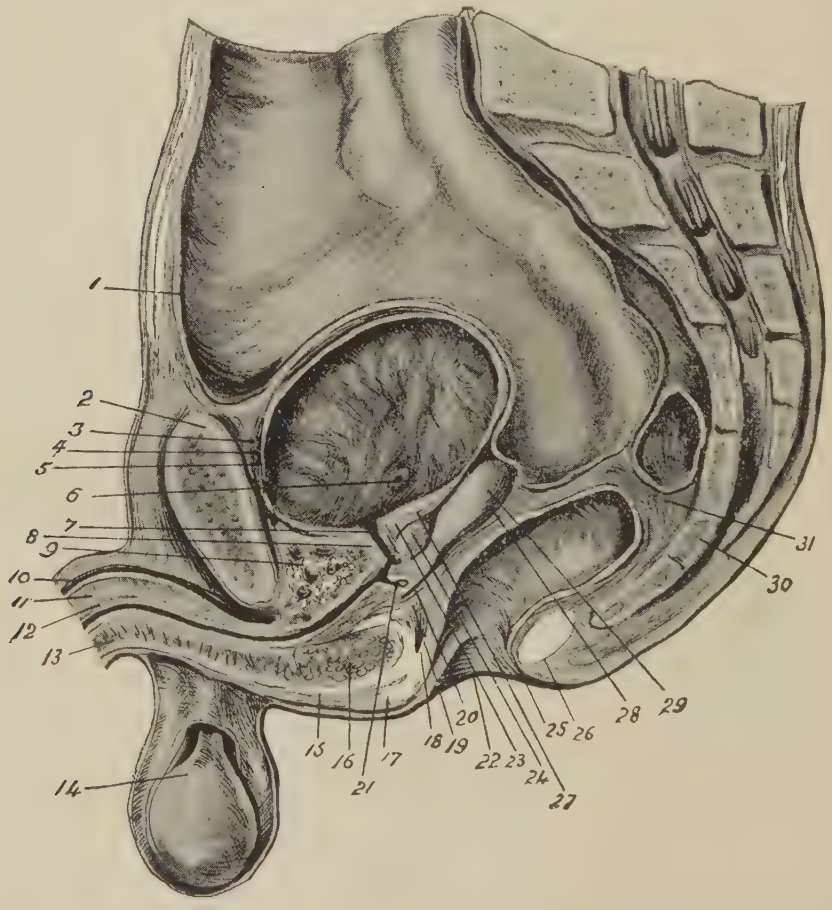

FIG. 25.—SAGITTAL SECTION OF A FROZEN MALE SUBJECT. The small intestine is removed. 1, peritoneum; 6, opening of the ureters; 8, internal sphincter vesicæ; 9, external sphincter, with the compressor urethræ muscle; 10, dorsal vein of the penis; 15, bulbo-cavernosus muscle; 16, bulb of the urethra; 17, sphincter ani; 21, utricle; 24, isthmus of prostate; 29, seminal vesicles. (Henle.)

most to the apex of the prostate, leaving only a small space below, less than 1 cm. long, between it and the prostate. On the upper surface of the urethra the fibers of the compressor continue back for a centimeter or more over the anterior surface of the prostate.

The internal sphincter surrounds the neck of the bladder and spreads out fanlike beneath the trigone of the bladder, reaching the ureteral mouths, and thus forming a connecting band between the ureters and the urethra.

The Vesicle Trigone.—Kalisher [1] has plainly shown that the trigone, i. e., the triangular portion of the bladder floor lying between the orifices of the urethra and of the ureters, belongs to the urethra and not to the bladder. The trigone develops with the urethra and the ureters, while the bladder is developed from the allantois. The muscle of the trigone is the internal sphincter. The mucous membrane contains papillæ and a few scattered glands (which the bladder proper does not). The circulation of the lower ends of the ureters, the trigone, and the prostatic urethra, is derived from the inferior vesical artery. The lymphatics of the trigone are more numerous than elsewhere in the bladder, and communicate directly with those of the posterior urethra.

Length.—The length of the urethra, varying as it does in different individuals and in the same individual with erection of the penis and hypertrophy of the prostate, may be set down as averaging 20.5 cm. ($8\frac{1}{4}$ inches),[2] and varying in different normal individuals from 18 to 23 cm. ($7\frac{1}{4}$ to $8\frac{3}{4}$ inches). The posterior urethra is usually 5.5 cm. ($2\frac{1}{4}$ inches) long—2.5 cm. (1 inch) to the membranous portion, 3 cm. ($1\frac{1}{4}$ inches) to the prostatic—and the anterior urethra 15 cm. (6 inches) long, subdivided as follows: 2.5 cm. (1 inch) to the navicular region, 6.25 cm. ($2\frac{1}{2}$ inches) to the penile, 3 cm. ($1\frac{1}{4}$ inches) to the scrotal, and 3 cm. ($1\frac{1}{4}$ inches) to the bulbo-perineal.

Diameter.—The diameter of the normal urethra (Fig. 26) varies even more than the length—it has been estimated at from 2 to 6 lines. A fair average is not larger than 0.75 cm. (0.3 inch); about No. 27, French scale. But, whatever its size, the urethra is not a tube of uniform caliber from end to end. It has naturally four points of physiological narrowing: the first at the meatus, the second at the peno-navicular junction, the third beginning about half an inch back of this, and becoming most pronounced at about the peno-scrotal junction. The fourth and fifth constrictions are the voluntary sphincter (the entire membranous urethra) and the internal involuntary sphincter (the

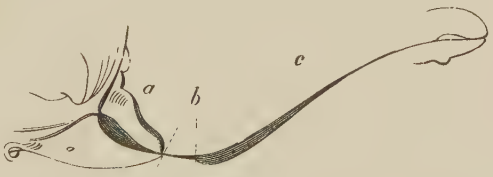

FIG. 26.—LONGITUDINAL SECTION OF URETHRA. (Thompson.) *a*, *b*, and *c* represent the prostatic, membranous, and spongy portions of the urethra.

[1] "Die Musculatur des Dammes," p. 151.

[2] Keyes, *Am. J. Med. Sci.*, 1898, cxvi, 125.

neck of the bladder). Of these five narrow points, three, it will be observed, are organic and situated in the anterior urethra, while the other two are muscular and situated in the posterior urethra. The muscular constrictions are widely dilatable, and the caliber of the canal is determined by the meatus, normally the narrowest point. Hence the caliber of the urethra is the caliber of its normal meatus. The peno-navicular and peno-scrotal constrictions are usually mere irregularities in the canal, besides which there are often lesser contractions at various points, making the urethra, when distended, not a smooth, evenly calibrated tube, but a very irregular one. The three chief *dilatations* of the normal canal are the fossa navicularis, which is situated just inside the meatus; the bulbous urethra, occupying a position immediately in front of the triangular ligament, and the prostatic urethra (Fig. 26). Of these the second is the larger.

Curve.—In relation to these variations of caliber Guyon's observations upon the relative qualities of the urethral roof and floor are of interest far more from a practical than from a theoretical point of view.[1] His observations may be classified as follows:

I. The roof of the urethra (when the penis is erect) forms an uninterrupted curve from the fossa navicularis to the bladder.

II. All the variations of caliber, except the fossa navicularis, are produced at the expense of the floor, which is, in consequence, very irregular.[2]

III. The mucous membrane of the roof is more closely adherent to the subjacent structures than that of the floor.

IV. The mucous membrane of the floor of the urethra is much more elastic than that of the roof.

Therefore, not only is the floor of the urethra more irregular than the roof, but its irregularities may be increased with much greater facility by any object introduced into the canal, as well as by disease. In other words, instruments, especially if small and rigid, may, with their points, furrow the floor of the urethra until, finally, they become pocketed (usually in the bulb), and so are brought to a full stop, while an instrument whose point impinges always on the roof avoids these obstructions and glides easily into the bladder. Therefore this eminent French surgeon has termed the roof the surgical wall of the urethra—the wall, namely, which is the guide to instruments entering the bladder. That fistulæ and false passages almost always occur in the floor and lateral walls, and that the orifice of a stricture is usually nearer the roof than the floor—these two facts make the roof the surgical wall in disease even more than in health.

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[1] "Leçons," ii, 309 *et seq.*

[2] Though not absolutely accurate, these two observations are clinically correct.

THE CURVE OF URETHRAL INSTRUMENTS

From these considerations it follows that *the curve of the urethra is the curve of its roof.* Now the entire anterior urethra is freely movable with the penis, and can be made to assume any curve. Not so the posterior canal. The membranous urethra, bound tightly at its extremities by the two layers of the triangular ligament, is the real fixed point of the urethra, and runs at a distance of from 1 to 2 cm. ($\frac{2}{5}$ to $\frac{4}{5}$ inch) below the symphysis pubis. In front of this the bulbous urethra tends slightly upward because of the tension of the suspensory ligament and of the skin and fascia, while a similar elevation is given to the prostatic urethra behind by the pubo-prostatic ligaments and the anterior fibers of the levator ani muscles. Thus is formed the so-called fixed curve of the urethra—not a true fixed curve, for by depression of the bulbous and the prostatic urethra to the level of the membranous portion it can be, and often is, transformed into a straight line, as when a sound is pushed home until its shaft is in line with the patient's body, or when straight metal instruments are introduced. The curve varies slightly in different persons, and in the same person at different periods of life, being shorter and sharper in the child, longer in the old man. An enlarged prostate lengthens the curve.

The proper average curve, as recognized by Sir Charles Bell and insisted on by Sir Henry Thompson—the one which will mathematically accord with the greatest number of urethræ—is that of a circle 8.125 cm. in diameter; and the proper length of arc of such a circle, to represent the subpubic curve, is that subtended by a chord of 6.875 cm. long.[1] An instrument made with a short curve of this sort will readily find its way through the normal urethra into the bladder without the employment of any force. It is very desirable that instruments intended for habitual use should be so constructed, inasmuch as many of the difficulties of catheterism are due to a defective curve in the instrument employed. The defect most frequently encountered is too great straightness of the last half inch—a deviation of the curve at its most important point. In an instrument properly made (Fig. 2) it will be found that a tangent to the axis of the curve *at its extremity* will intersect the projected axis of the shaft at a little less than a right angle (*n k h*). If the curve comprised only a quarter of the circle, the tangent would meet the projected shaft at a right angle (*m g h*); but instruments made a little longer, as they are usually found, invariably have the *last part of the curve* tilted off into a faulty direction, as shown in Fig. 2, making the angle between a tan-

[1] In the winter of 1852–53, assisted by the late Dr. Isaacs, I made a series of careful experiments upon sections of frozen subjects, as well as by injecting the urethra with numerous substances, afterwards carefully cutting out the casts. I found the average curve to be identical with the one given above.—Van Buren.

gent to the axis of the curve at this point and the projected axis of the shaft obtuse (*l j h*), and falling within the right angle.

The choice between instruments with the Van Buren curve (*b o h*) and the Béniqué curve (*d o h*) is largely a matter of taste and habit. The impatient manipulator will always do better with the short curve. The Béniqué curve, by adapting itself more fully to the fixed curve of the urethra, enters more easily for the patient. But its point is wabbly. It must be introduced much more deliberately than the straight-shaft instrument. I used the straight shaft ten years before giving it up for the Béniqué.

PHYSIOLOGY OF THE URETHRA

Sensibility.—Under normal conditions the sensibility of the anterior urethra is slight, although it is exquisitely sensitive when inflamed. The prostatic urethra may be excessively sensitive, while the membranous portion of the canal is always somewhat sensitive. Indeed, the first passage of an instrument through this part of the urethra of a nervous individual is attended not only by pain, but also by a decided shock. He becomes pale and nauseated, may even faint, if not already in a recumbent position; while the recorded deaths ensuing upon this simple maneuver, though few, attest its severity.[1] This acute sensibility becomes rapidly deadened, unless the canal is inflamed, so that after a few repetitions the operation is attended by no shock and but little, if any, pain.

This *urethral shock* is an important element in many cases of so-called urinary fever. It is rarely the sole cause of death, but often contributory by its reflex action upon diseased kidneys, and tingeing the frankly septic cases with a neurotic element not otherwise to be explained. Moreover, it contributes to the elucidation of the mystery of urethral neuralgia and urethral spasm, and is doubtless concerned in the explanation of the fact that the form of septicemia known as urinary fever, so common after injury to the deeper portions of the canal, becomes less and less to be feared the farther forward the injury, and is unheard of when the trauma affects only the balanitic portion of the canal.

Mobility.—The *muscles* of the penis and urethra are thrown into action only during urination or erection and emission, and their functions are therefore more fitly described under these titles. A few words concerning *the cut-off muscle* may not be amiss in this place. Besides its most important function of preventing the urine from escaping from the bladder by an effort of the will and of cutting off the stream, it pre-

[1] They are doubtless due to *status lymphaticus*.

sents several interesting physiological characteristics. The urethra in front of the cut-off muscle swarms with bacteria, while all beyond is germ-free. This is so, not because the muscle presents an impassable barrier, for it does not. When violently contracted it doubtless does form an insurmountable barrier to bacterial invasion, but its periods of contraction, like those of the external sphincter ani—to which it bears a close resemblance—are comparatively infrequent and of short duration. Its normal tone, however, is sufficient to make the channel a narrow and difficult one, readily cleansed of any chance invader by the periodical outflow of urine. It is suggestive, moreover, that the cut-off muscle surrounds the most sensitive part of the urethra. Hence the cause of spasm in this muscle, whether acute from some local or general shock, or chronic as a specific evidence of a neurotic habit, is not far to seek.

TECHNIC OF THE PASSAGE OF SOFT URETHRAL INSTRUMENTS

Antiseptic Preparations.—The instruments are sterilized, the operator's hands washed, and the meatus and glans cleansed as described in Chapter III.

Lubrication.—The object of lubricating a urethral instrument is *not to make the instrument slippery, but to let it slip through the meatus.* A small dab on each lip of the meatus is all that is needed, and this is best applied, not by greasing the whole shaft of the instrument, but by transferring a bit of lubricant to its tip, and with it smearing the lips of the meatus.

Position of the Patient.—The patient should lie flat upon his back for the first instrumentation, since this sometimes causes marked nervous shock. Indeed, it may make the patient faint. But for subsequent operations the patient may assume any convenient position: he may lie, sit, or stand.

Introduction of the Instrument.—The catheter is readily introduced as far as the bulbous urethra. Up to this point the urethra offers no obstruction, unless the meatus is unusually small (p. 247). But unless the penis is held at right angles to the patient's body, the bend of the urethra at the point of attachment of the suspensory ligament (just back of the peno-scrotal angle) offers a slight resistance.

At the junction of the bulbous and the membranous portions of the urethra the catheter encounters the compressor urethræ muscle. This muscle may present a scarcely perceptible obstacle or it may be excited to reflex spasm of such intensity as to prevent the entrance of the catheter.

Method of Overcoming Spasm of the Compressor.—When the advance of the catheter is obstructed by the compressor urethra the tip of the in-

strument may lie just within the grasp of the outer fibers of this muscle or it may pass down into the pocket of the bulb.

The first maneuver to overcome this obstacle is to crowd the catheter gently but firmly into the urethra and hold it there for half a minute. On releasing the catheter it either springs back or remains in place. If it springs back it may be taken for granted that the tip of the instrument is pocketed in the bulb, and does not present at the opening of the muscle; it must then be removed and another instrument selected. But if the catheter does not spring back it may again be crowded against the muscle in the hope that a slight advance has been made and that further pushing will finally overcome the spasm.

The second maneuver is to select an instrument that will present its point accurately at the orifice of the muscle and have sufficient rigidity to overcome the spasm. The best instrument for this purpose is the olive-tipped, elbowed catheter.[1] It usually slips readily into the posterior urethra.

The third maneuver is to aid the passage of the olive-tipped elbowed catheter by gentle pressure upon the floor of the bulbous urethra by a finger against the perineum, while with the other hand the catheter is gently pushed forward.

The fourth maneuver is to replace the woven instrument by a metal one, and to pass this according to the rules laid down below. If properly performed, this maneuver always succeeds.

Method of Passing the Neck of the Bladder.—When a flexible catheter has passed the compressor muscle of a normal urethra it enters the bladder without further difficulty. But if the catheter stops we know that its point has caught in the floor of the prostatic urethra in front of the internal sphincter. An elbowed catheter rarely catches in this pouch; a straight catheter may be lifted out of it by pressure with a finger introduced into the rectum.

TECHNIC OF THE PASSAGE OF METAL INSTRUMENTS

The penis, properly cleansed (p. 28) and with foreskin drawn, is held at right angles to the patient's body while the lips of the meatus are lubricated by a touch with the tip of the instrument.

The shaft of the instrument is held over the fold of the groin, its handle nearly in contact with the skin, from which latter (the integument, first of the groin and then of the abdomen) it is not to be removed until the point of the instrument is about to enter the membranous portion of the urethra. The instrument, at first held along the groin, with point high and handle low (Fig. 27), is introduced at the meatus, and

[1] The straight olive-tipped or the blunt-elbowed catheter will often serve a like purpose.

the penis molded up over it. It is not pushed into the urethra, but the urethra is made to swallow the instrument, as it were.

When the curve, and perhaps an inch of the shaft, has disappeared within the meatus, the handle of the instrument is swept around over the surface of the belly, so as to lie exactly over the linea alba, parallel with it, and still close to the integument. The whole shaft of the instrument is now to be gently pressed toward the feet, being still kept close to and parallel with the surface of the belly (the penis, meanwhile, being lightly grasped behind the corona glandis and held steady).

Fig. 27.—Introduction of Sound.

The point of the instrument should be followed with the little finger of the hand which manages the penis, and, when it gets fairly past the peno-scrotal angle, the whole scrotum, with the testicles and penis, should be largely seized with the hand and pressed against the pubis, with slight upward traction (Fig. 28). The point may now be felt to settle down and adapt itself to the subpubic curve, after which the weight of the instrument, properly directed, should carry it into the bladder.

As soon as the curve lies well against the symphysis, the scrotum, testicles, and penis should be dropped; the hand which held them takes the instrument, steadies it in the median line, and gradually carries the shaft away from the abdomen (Fig. 29), making the handle describe the arc of a circle, and depressing the shaft between the thighs until it lies nearly in the same plane with them. No pushing movement should

be imparted to the instrument during this time. The handle is made to describe the arc of a circle, and in a healthy urethra the point cannot go astray. While the instrument is being depressed between the thighs, the free hand is employed in pressing down upon the mons veneris and

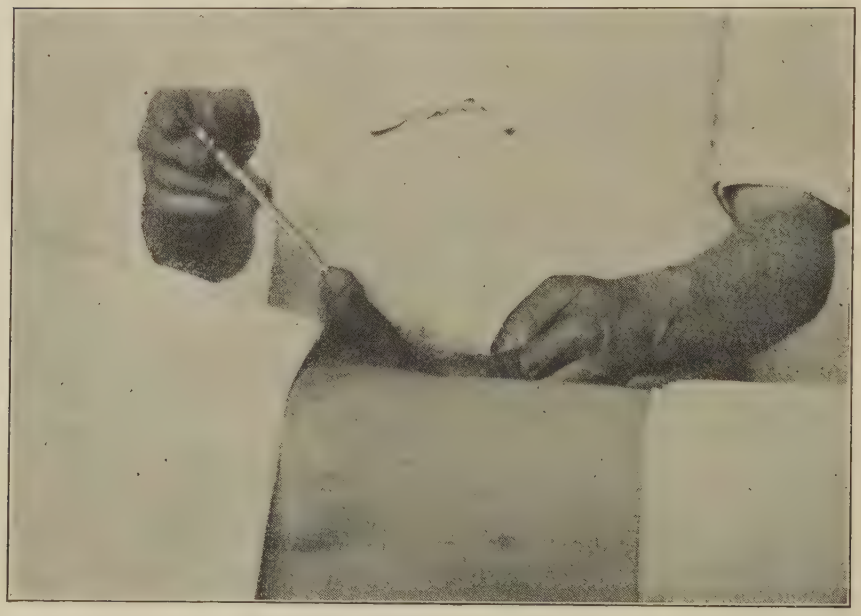

Fig. 28.—Introduction of Sound.

the root of the penis (Fig. 29), to stretch the suspensory ligament—a point of importance to the easy introduction of an instrument.

The instrument should be withdrawn with the same deliberation and care with which it is introduced. No traction is needed. The motions used in introduction are simply reversed. The handle of the instrument is lightly caught, and without traction made to describe the arc of a circle until it touches the abdomen over the linea alba. It is then carried around to the groin, and, by a tilting motion, unhooked from the urethra, ending exactly where it commenced along the groin, the handle low, the point high.

The first principle of instrumentation in the urethra is to avoid the use of force. Even in a healthy subject the beak of the instrument may become pocketed in the floor of the urethra. It is to avoid this that upward traction on the scrotum and penis is made, whereby the beak of the instrument is held in contact with the roof of the urethra, the surgical wall, until it gently slides of its own weight into the bulb and impinges against the triangular ligament. Here the beak of the instrument naturally sinks into the sinus of the bulb, and ceases to advance. Now

it is that the operator, by pressing downward the mons veneris, tilts the instrument so that its beak touches the roof of the canal, and slides gently into the membranous urethra, the cut-off muscle relaxing before it. But often the beak is not so readily liberated. That it is still caught in the bulb may be known by the bulging out of its curve in the perineum as the shaft is being depressed between the thighs, and by the rebound of the handle when liberated. The obstacle is overcome by gently maneuvering the point of the instrument, by partial withdrawal and re-introduction, or by slight depression of the beak, then lifting it over the obstacle with a finger in the perineum, at the same time pressing down upon the shaft of the instrument to make its point sweep the roof of the canal. As a last resort the tip of the instrument may be helped over the obstacle by a finger introduced into the rectum. The dangerous *tour de maître* [1] should never be tried, nor any force used in the manipula-

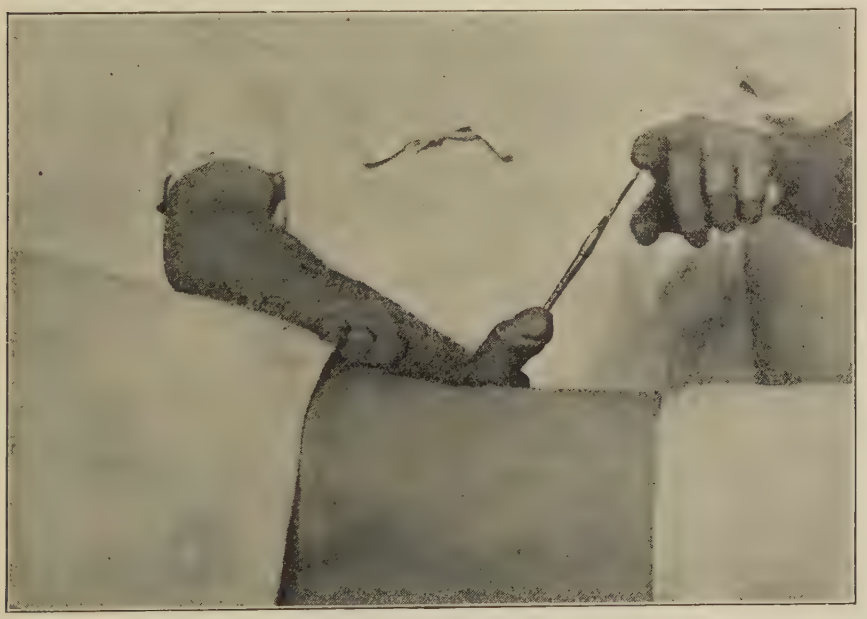

Fig. 29.—Introduction of Sound.

tions at this point, as a false passage is easily made here and under these very circumstances. The depression of the handle of the instrument alone is capable of exerting enormous power. The sound represents a lever of the first order, and the surgeon has the long arm.

[1] The *tour de maître* consists in introducing a sound with the shaft between the patient's legs until the point is arrested at the bulb; then the handle is rapidly made to describe a semicircle until it reaches a vertical position, when it is at once depressed between the thighs. This is brilliant but dangerous.

With a little patience a suitable instrument will always pass into the bladder unless there is a stricture. When the point has traversed the membranous urethra it must continue on freely if the prostate is normal. The so-called spasm of the neck of the bladder does not exist as an obstruction to the passage of instruments.

The sound need only be introduced far enough to bring its greatest diameter into the membranous urethra. This is accomplished when the shaft has been depressed almost, but not quite, to the plane of the body. To pass it farther, so as to straighten out the prostatic urethra, is unnecessary, painful, and, in certain cases, dangerous.

Instruments small enough to engage in the sinuses of Morgagni are not used in the healthy canal. Instrumentation in morbid conditions will be detailed in connection with the different diseases requiring it.

The *cystoscope* and the *stone searcher* are introduced in the manner above described; but the depression of the handle is carried far enough to permit the angle of the instrument to slip over the bladder neck, an occurrence signalized by a distinct jerk on the part of the instrument.

The sensation experienced by a healthy urethra is that of hot points pricking the canal along the part being traversed by the foreign body. As the instrument enters the membranous urethra, a desire to urinate begins to be felt, which increases as the prostate and the neck of the bladder become distended by the instrument, so that the patient sometimes believes the urine is flowing away, in spite of the surgeon's assertions and his own observation to the contrary. Nausea, and even syncope, may occur as the instrument distends the prostate, especially on the first introduction in sensitive young people. Occasionally distention of the prostatic sinus produces a partial erection.

If the patient faints, the instrument should be withdrawn at once and the legs elevated, while the head is hung over the edge of the lounge upon which he lies. The facility with which this may be done, if necessary, is one of the reasons for placing the patient on his back for his first catheterization.

The more serious *complications* of catheterization, such as false passages, urethral fever, etc., will be considered in the succeeding chapters. Ordinarily speaking, none of these complications need be expected to follow the gentle passage of a clean instrument into a urethra which is neither inflamed nor lacerated; but in order to avert the possibility of cystitis or chill it is safe to *terminate every catheterization or sounding by an instillation along the whole urethra of a few drops of silver-nitrate solution* (1:1,000), unless some other solution is used as a part of the treatment, or the temper of the urethra is well known.

CHAPTER V

CYSTOSCOPY

By Dr. B. S. Barringer

INSTRUMENTS

The principle upon which modern cystoscopy is built is, according to Von Frisch, "the introduction of the source of light into the bladder and increasing the range of vision by the insertion of an optical apparatus."

Observation Cystoscopes.—These are of two general types: the indirect, or prismatic, and the direct. In the indirect the line of vision is at right angles to the shaft of the instrument, the rays of light being deflected 90° by the rectangular prism (Fig. 30), and the image inverted. With the direct cystoscope the rays of light are not deflected and the line of vision corresponds with the shaft of the instrument, the image appearing in normal position (Fig. 31). Both of these cystoscopes magnify the image. The differences and individual excellences of these two types of cystoscopes will be discussed under catheterizing cystoscopes. In Europe the prismatic cystoscopes are almost exclusively used, while the use of the direct instruments is practically confined to America. In this country, however, there seems to be a decided and growing trend in favor of the indirect cystoscope.[1]

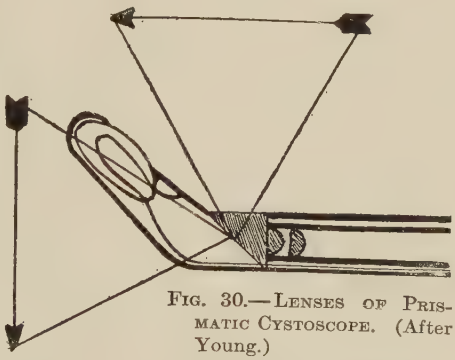

Fig. 30.—Lenses of Prismatic Cystoscope. (After Young.)

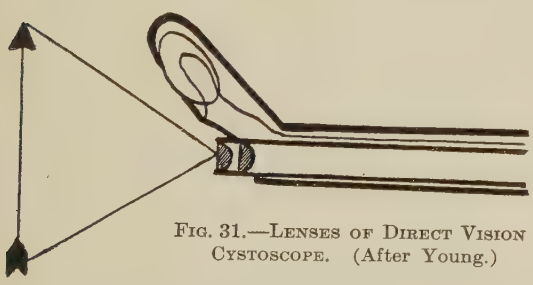

Fig. 31.—Lenses of Direct Vision Cystoscope. (After Young.)

[1] The writer uses exclusively the prismatic cystoscope and in any portions of these chapters where cystoscopy is referred to the indirect instrument is the one which has

Irrigating Cystoscopes.—Earlier cystoscopes, especially those of the prismatic type, were not irrigating. That is, if for any reason the bladder fluid became clouded or the lens dirty while the cystoscope was in place, the entire instrument had to be removed for purposes of cleansing either the instrument itself or the bladder. To-day all examining cystoscopes should be irrigating.

There are three different types of irrigating cystoscopes. First, the cystoscope composed of an outer sheath and an inner telescopic tube; the tube may be removed while the sheath is left in place in the urethra, and irrigation may be performed through the sheath. The Otis cystoscope is of this type. Second, the irrigation may take place with the tube in position, but the flow is interrupted, first in and then out. Such is the Nitze irrigating cystoscope, as the telescopic tube is not separable from the sheath. And, third, the irrigation may be continuous, as in the Willy Meyer cystoscope. This last cystoscope, combining the features of continuous irrigation with a separable sheath and telescope, is probably the most satisfactory irrigation cystoscope, while the Tilden Brown is the best of the direct instruments.

The Kelly Cystoscope and Modifications.—The Kelly cystoscope for women has long been used with success by many cystoscopists. It consists of a straight tube with a mandrin, which is removed after its introduction. The light is reflected from without by means of a mirror. Modifications of this instrument have been made by Chetwood and Garceau, placing the light within the tube and magnifying the field; and by Luys, who has perfected a cystoscope for use in men. These instruments should only be used for intravesical operations.

Operating Cystoscopes.—The Nitze and the Bierhoff and Caspar modifications are the best operating cystoscopes. The Kelly and Luys open cystoscopes may sometimes be employed.

These instruments may be used in removing foreign bodies, crushing small stones, and for such operations as enlarging contracted ureteral orifices, etc. They should not be used to remove papilloma or other growths from the bladder even for diagnostic purposes.

Photographic Cystoscopes.—These have been of use to obtain pictures of various bladder conditions. The pictures, however, are generally too poor to be of much value.

TECHNIC OF CYSTOSCOPY

Cystoscopy is a surgical operative procedure, requiring the same aseptic technic as any other surgical procedure. The technic of cys-

been used. A prismatic rectifying lens may be added to the ocular end of the instrument; but this diminishes the field of vision and the method of manipulating the instrument may be as readily learned without it.

toscopy, as here given, is applicable for the direct, indirect, composite, and retrograde instruments.

The following articles are necessary for a cystoscopic examination:

Current transformer for attachment to electric light, or portable battery.

On sterile table:

Cystoscopes with cords, extra lights, and irrigating attachment.
Silk coudé catheters, 16 to 18 F.
Silk olivary catheters, 16 to 18 F.
Metal sounds, 24 to 26 F.
Keyes instillator,[1] with 10 c.c. syringe.
1 basin of sterile boric solution.
1 basin of bichlorid of mercury (colored blue).
1 syringe, capacity 100 to 200 c.c.
1 small hypodermic syringe.
1 large hypodermic syringe.
1 tube of lubricant.
1 tube of alypin lubricant (5 per cent).
Sterile towels and sponge wipes.
Sterile perforated leglets.
2 large and 2 small glasses.
Finger cots.
Morphin sulphate, $\frac{1}{8}$-gr. tablets.

If a more extensive examination, ureteral catheterism, or urinary separation is to be done, to the above should be added:

Catheterizing cystoscope with ureteral catheters of different sizes, with bank pins.
1 bottle of sterile 4 per cent indigo carmin.[2]
1 bottle of 1 per cent phloridzin in 33 per cent alcohol.
Luys separator with extra rubbers.
2 or more sterile bottles.

Most of these implements may be sterilized by boiling. The cystoscopes, cords, silk catheters—ureteral and urethral—outside of bottles of solution, etc., which cannot be boiled, are placed in an air-tight instrument case and sterilized for one hour with formaldehyd gas. The formaldehyd is generated by the Lowe disinfecting lamp. This lamp is filled with wood alcohol; the alcohol, coming in contact with a heated platinum coil, generates formaldehyd.

Sterilization of the Cystoscope.—Perfect sterilization of cystoscopes, and particularly catheterizing cystoscopes, requires that the different portions be taken apart and manually cleaned with green soap and

[1] With large bore, to transmit lubricant.

[2] This is made up in sterile salt solution and boiled two hours.

water. Catheterizing cystoscopes of the type of the Nitze cannot be so cleaned. This is a distinct disadvantage. Most of the direct and several of the indirect catheterizing cystoscopes, such as Brown-Buerger, can be properly cleaned.

After cleaning all parts of the cystoscope, using alcohol, if necessary,[1] to remove any grease, the instrument is placed in the formaldehyd cabinet for at least one hour. Or if, instead of formaldehyd gas, it is desired to use a solution for disinfection, any noncorrosive antiseptic fluid may be used, 95 per cent alcohol being probably the best. For this purpose an upright glass holder should be used, so that the shaft can be immersed and not the eye piece.

Preparation of the Patient before Examination.—As a rule no preexamination preparation is necessary. If, however, the patient be in poor condition, if he be old, and particularly if he have retention (from prostatic hypertrophy, etc.), a preliminary course of urotropin, gr. v, t.i.d., should be given for at least forty-eight hours.

If the patient be nervous or hypersensitive, gr. ¼ of morphin sulph. may be given one half hour before the examination.

The urethra must be penetrable by the instrument. Occasionally meatotomy or urethrotomy has to be done prior to the cystoscopic examination, and occasionally, for convenience and expedience, the cystoscopy may be performed through a perineal wound. Such a cystoscopy is as easy as through the urethra, although the relation of the landmarks of the bladder are changed. Ureteral catheterism through the perineal incision is apt to be more difficult than in the usual way.

Position on Table.—The position most satisfactory to the operator and most comfortable to the patient is the sitting position, the back slightly reclining, with the pelvis at the edge of the table and the feet upon supports below the table level. The table should be of a sufficient height to make manipulations by the cystoscopist easy. Using this position, the examination can be easily performed at the house of the patient by using a common kitchen table, or even at the edge of the bed.

Cleansing of Field.—The entire penis should be cleaned with green soap and water, followed by an antiseptic wash (preferably 1:10,000 bichlorid of mercury) and wrapped in a piece of gauze wet in this solution. Sterile, perforated leglets, reaching well up on the abdomen, should be put on the patient, the penis drawn through the perforation.

Anesthetization.—*Local Anesthesia.*—The best anesthetic which we know at present, combining the feature of good anesthesia with a toxicity less than that of cocain, is *alypin*. We have used alypin for the

[1] Some writers say that alcohol disintegrates the cement around the lens and lamp. Such has not been my experience.

last year in cystoscopic work, using as much as 25 c.c. of a 2-per-cent solution (0.5 gm.) in the urethra and bladder with no toxic effects. Cocain, even in a 2-per-cent solution, should not be used in the urethra, as deaths [1] from a small quantity of a 2-per-cent solution have been reported. Beta eucain, 2 per cent, is safe, but a poor anesthetic. Stronger solutions, e. g., 4 per cent, act as an irritant to the urethra.

General Anesthesia.—One or two per cent of adults, and all children, require general anesthesia for cystoscopy.

Method of Anesthesia.—The most satisfactory way to anesthetize the urethra, and particularly the posterior urethra, is instillation with a Keyes instillator of 5 per cent alypin in the sterile lubricant, described on p. 30.

A 10 c.c. syringe is filled with this and attached to the instillator. If the anterior urethra is sensitive a small amount of the alypin may be injected as the instrument is introduced. When the posterior urethra is reached about 4 c.c. is instilled, and the instrument is withdrawn. In this way about 5 to 7 c.c. of the 5-per-cent alypin lubricant (0.25 to 0.5 gm. of alypin) are used, and the analgesia is more satisfactory than that produced by cocain in 2 per cent solution. The alypin should be allowed to remain in the urethra for ten minutes before beginning manipulations.

It is rarely necessary to anesthetize the bladder itself if the posterior urethra and bladder neck be properly anesthetized. Antipyrin solution and other solutions have been recommended for bladder anesthetization. Probably as satisfactory as any is 4 drams of a 1- or 2-per-cent alypin solution.

It is well to remember that the gentler the manipulations the longer the anesthesia lasts. At most a good anesthesia lasts but half an hour.

Bladder Preparation.—The minimal bladder capacity in which I have performed cystoscopy is 50 c.c. If the capacity is even less than this cystoscopy may be attempted under general anesthesia.

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[1] John A. Wyeth, M.D., *Folia Urologica*, March, 1908. The patient was suffering from "a close stricture" of the urethra. "In order to deaden in a measure the pain which would be caused by the introduction of a catheter I threw a dram of two per cent solution cocain in the urethra, where it remained for about a minute. . . . I then attempted to find the opening (in the urethra) with a Banks's whalebone dilating filiform bougie. This effort lasted probably ten or fifteen minutes and was unsuccessful. . . . I desisted for a short while, and as he complained of great pain in the first trial, I introduced a small quantity of the same solution of cocain, but this had scarcely left the point of the injection syringe, when he complained of a peculiar fainting sensation, placed one hand on the chest in the region of his heart, and was immediately seized with convulsive movements and expired within one or two minutes." As nothing was mentioned in the autopsy report about *status lymphaticus* I assume this to be a case of cocain poisoning.

The solutions used for irrigating and filling the bladder for cystoscopic work are boric solution (2 per cent), normal salt solution, or water, all of them sterile and warm.

The bladder may be irrigated by means of a catheter of rubber or silk, and the cystoscope introduced thereafter; but the better way, involving the passage of but one instrument, is to introduce the cystoscope immediately and to irrigate the bladder through the sheath or irrigating attachment. This procedure is of course not possible when cystoscopes are used in which the telescopic portion is not separable from the sheath.

In irrigating the bladder, either through the sheath of the cystoscope or through a catheter, only small quantities of fluid (50 c.c.) should be used at a time. The bladder should not be filled to its capacity and then emptied. The reason for this is that if a bladder contains much pus, the pus settles to the bladder base, and the bladder is much more quickly cleansed with small quantities of fluid, frequently introduced. This is specially so if pus is being rapidly excreted into the bladder from the kidneys.[1] When the return flow is entirely clear, as shown by holding the fluid in a clean glass up to the light, the telescopic portion of the cystoscope is introduced and the *bladder filled to its capacity* through the irrigating attachment. Our method has always been to ask the patient to tell when he feels a *slight desire to urinate. The bladder is not to be filled beyond this point.*

By irrigating through the sheath of the cystoscope instead of through a catheter, practically every bladder may be cystoscoped, if the patient can be sufficiently anesthetized. Moreover, by this method the time of cystoscopy or ureteral catheterism is reduced about one half.

Testing the Instrument.—Before the introduction of the instrument into the bladder the cystoscope should be attached to the rheostat and the light tested. The cause of the failure of light is most frequently found, if the light is not burned out, in the contact between the light and the instrument. This is remedied in unscrewing the lamp and elevating the wire with a knife blade and, if necessary, cleaning the contact piece in the cystoscope. Another source is short-circuiting by the entrance of water between the lamp and the cystoscope. To avoid this the screw of the lamp may be lubricated with vaselin before being screwed home. The contact between the connecting cord and the cystoscope may also be faulty. This contact may be unclean or wet. As the source of the failure of light may be in the cord itself, it is well to have an extra reserve cord. Other defects must be remedied by the instrument maker.

[1] Irrigations with *cold solutions* seem to have some effect in diminishing the frequency and force of the ureteral contractions, and thus aiding in cleansing a bladder where the pus is of renal origin.

If the light works it is turned up to the desired height before the introduction of the cystoscope. In this way we know how much light is on and also that we shall probably burn out the light if we turn on much more current.[1]

Lubrication.—Sterile glycerin is an ideal lubricant. If alypin lubricant has been injected no further lubricant is required.

Introduction of the Instrument.—There are a very few cases in which it is impossible to introduce the cystoscope. But improvement in construction has made the modern instrument smooth and *round*, and these cases have become rare. The two places where the cystoscope may give trouble are at the cut-off muscle and in the prostatic urethra. If, in spite of extreme care and gentleness, the cystoscope does not pass the cut-off muscle, the following expedients are used:

First, have the patient breathe in and out rapidly, but gently ("pant like a dog"); second, exert deep pressure in the suprapubic region; third, place a finger in the rectum, which acts as a guide and also relaxes the cut-off muscle. This rectal finger may also help to guide the cystoscope through the prostatic urethra.

Removal and Irrigation.—Removal of the cystoscope is much easier than the introduction, and the steps are simply reversed. Before removal it is well to empty the bladder of its fluid and inject one or two ounces of silver nitrate (1:10,000) or other antiseptic solution (protargol, 0.5 per cent) in the bladder, which the patient passes after the instrument is removed.

Indications for Cystoscopy.—1. All cases of hematuria or pyuria not urethral in origin.

2. All cases (except acute cystitis) where the symptoms or physical signs point to involvement of the bladder, ureters, or kidneys.

3. Neuroses of the urinary organs, to determine, if possible, their origin.

4. Various perivesical conditions, to determine if the bladder is involved; as, for example, in uterine carcinoma.

Contra-indications to Cystoscopy.—The contra-indications have become fewer as the technic has improved.

1. Acute inflammatory conditions of the urethra, bladder, prostate, seminal vesicles, or epididymis.

2. Rare septic cases in old people; e. g., sepsis from prostatic retention, when the general condition of the patient is poor. In these cases a preliminary drainage of the bladder should precede the cystoscopy.

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[1] With the modern incandescent lamps burning out of lamps should be practically unknown. In the past four years during some hundreds of cystoscopies we have burned out but two or three lights and this because of our own carelessness.

Dangers and Difficulties of Cystoscopy.—Most of these have been already dealt with. Careful sterilization and bladder irrigation after the cystoscopy should prevent infection in almost all cases. Burns of the bladder are perfectly possible with the modern cold lamps, but care in not keeping the lamp in contact with the bladder for any length of time will prevent this. I have never seen a burn. Some of the presumably cold lamps are really hot. All lamps should be tested as to whether they are really cold by holding them between the fingers when lighted.

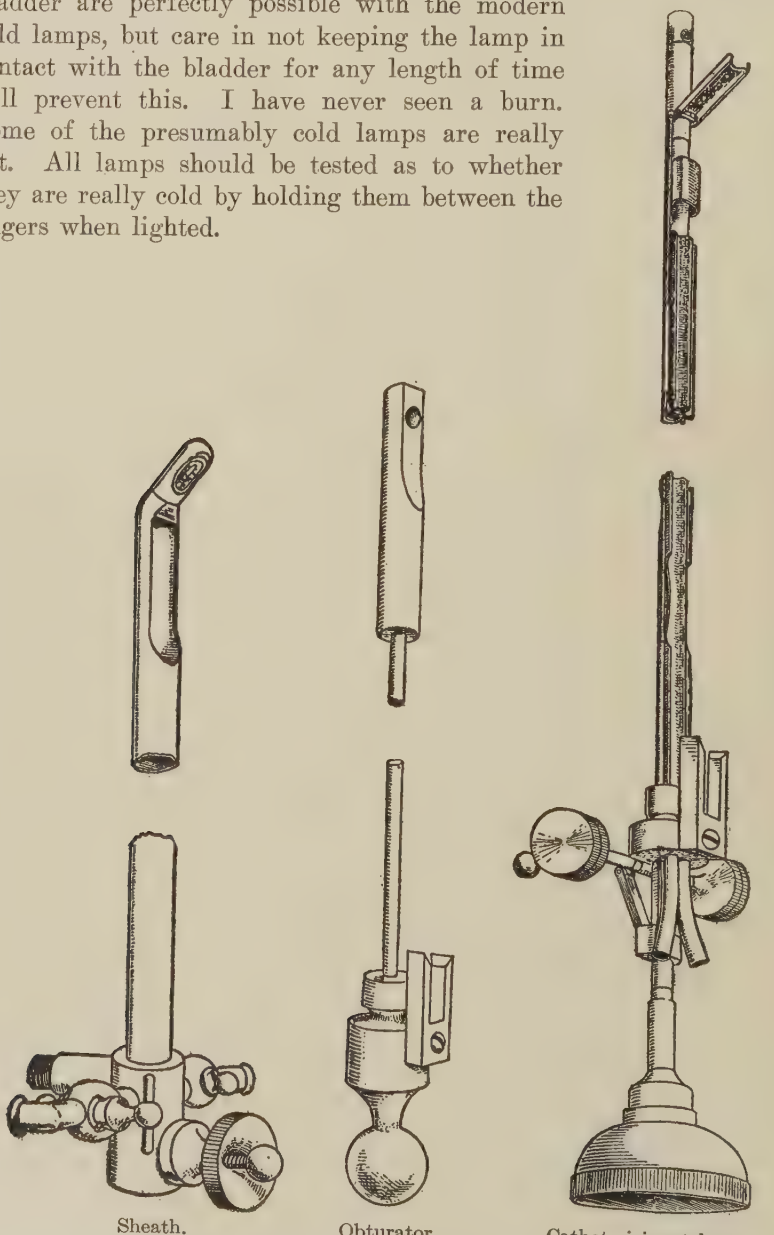

FIG. 32.—BROWN-BUERGER CYSTOSCOPE. (Buerger.)
(Observation telescope not shown.)

OBTAINING THE SEPARATED URINES FROM EITHER KIDNEY

Ureteral Catheterism

Instruments.—The two types are the prismatic and direct. The best instruments in our experience are the Brown-Buerger prismatic and the Tilden Brown direct (Figs. 32 and 33). Both of these instruments have a round outer sheath with a removable catheter-carrying telescope, with grooves for two ureteral catheters. The size of the Brown-Buerger is 22 F., carrying two 5 F. catheters, and 24 F., with two 7 F. catheters. The Tilden Brown is 22 F., with tubes for two 6 F. catheters.

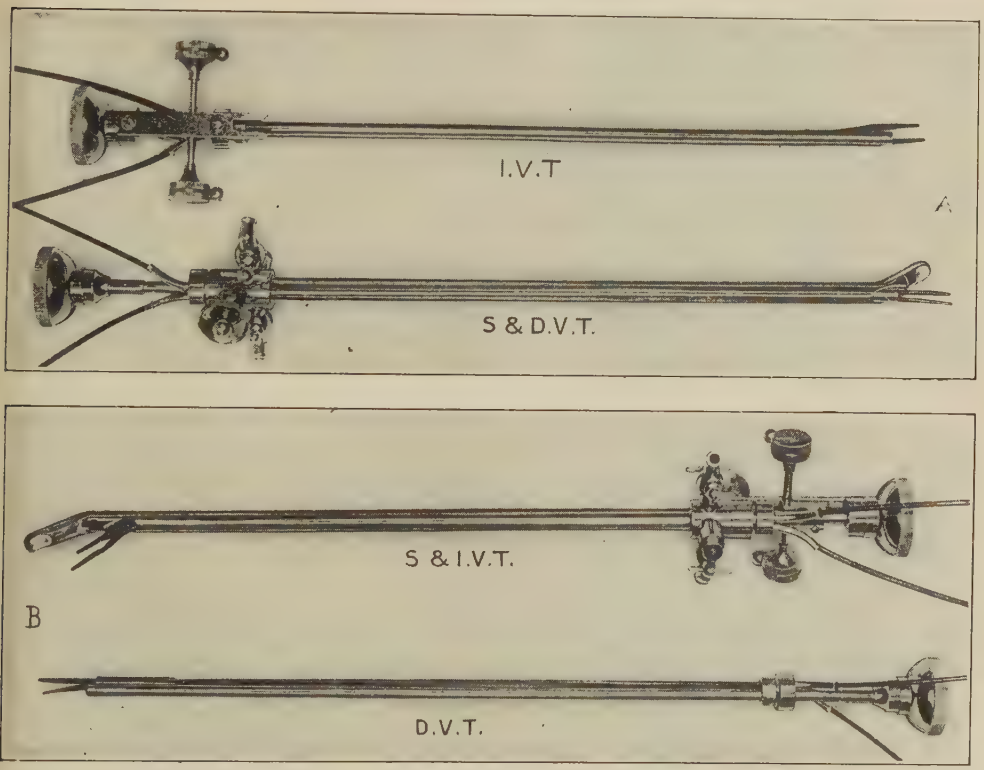

Fig. 33.—The Brown Composite Cystoscope. *A*. I. V. T. Indirect view catheter telescope. S. & D. V. T. Sheath with direct view catheter telescope inserted. *B*. S. & I. V. T. Sheath with indirect view catheter telescope inserted. D. V. T. Direct view catheter telescope.

Both instruments have observation telescopes which may be used prior to the ureteral catheterism. In the Brown-Buerger, the Albarran lever has been utilized to deflect the ureter catheter. This lever is not necessary in the direct instrument. Both instruments are irrigating.

The principal differences between these two types of cystoscopes are: First, *the ureteral orifice is much more easily found with the prismatic cystoscope.* Second, *after the orifice is found it is easier to introduce the ureter catheter with the direct cystoscope.*

Fig. 34.—Flute-tipped Catheter. Eyes at *A, B, C.*

Ureter Catheters.—The best type of ureter catheter is that used by Albarran, with the flutelike terminal and two lateral openings (Fig. 34). If these be marked off in centimeters, with an especial mark every 5 centimeters, the depth to which they are introduced into the ureter may be easily noted. If these catheters are of sufficient size (generally 5, 6, or 7 F.), extra-catheter flow may be excluded, and we obtain all the urine from either kidney. The Nitze balloon catheters are impracticable.

Fig. 35.—Pin Corking Catheter.

Technic of Ureteral Catheterism with the Prismatic Cystoscope.—*First find the ureters.* The ureters are connected by a ridge, the interureteral ridge, which forms the posterior boundary of trigone. The trigone is a flat area, differentiated from the rest of the bladder by its marked vascularity. Posterior to the trigone, the bladder falls away to form the bas fond. The interureteral ridge, therefore, has three landmarks: it is at the base of the bladder, it is at the point where the very vascular trigone meets the less vascular bas fond, and posterior to the ridge the bladder dips down.

To find the ridge the beak of the cystoscope is pointed directly down in the median line (Fig. 36 [1]) and the bas fond is seen. Now the cystoscope is withdrawn until the line of demarkation between the vascular trigone and the less vascular bas fond is seen (Fig. 37 [1]). This is the interureteral ridge. Occasionally the ocular end of the cystoscope has to be considerably depressed to bring the interureteral ridge in view, and occasionally the position of the ridge is taken by an enlarged middle lobe of the prostate (Pl. III). Having found this ridge, the cystoscope is rotated (Fig. 36 [2]), following the ridge, and at its end the ureter is found (Fig. 37 [2]). When the ureter is first seen it is generally small (Fig. 37 [3]) and a considerable distance away from the cystoscope, and, therefore, impossible to catheterize. *Keeping the ureter in view,* the entire vesicle end of the cystoscope is now moved laterally toward the orifice (to the right or left, according to which ureter) by moving the ocular end away from the side to be catheterized (Fig. 36 [3]).[1]

[1] This is the one accurate way to find the ureter and the method (described by Jacoby, *Folio Urologica*, June, 1907, p. 89) may be likened to finding the appendix by following the muscular bands of the large intestine.

FIG. 36.—MANEUVERS IN CATHETERIZING RIGHT URETER (PRISMATIC CYSTOSCOPE). 1. Cystoscope turned to "six o'clock" to find interureteral ridge (Fig. 37, 1). 2. Cystoscope rotated, following ridge (Fig. 37, 2 and 3). 3. Beak of cystoscope moved toward ureter (Fig. 37, 4).

FIG. 37.—LANDMARKS IN CATHETERIZING THE RIGHT URETER (PRISMATIC CYSTOSCOPE). 1. Cystoscope at "six o'clock" (cf. Fig. 36, 1). Vascular trigone above, *bas fond* below, interureteral ridge between. 2. Cystoscope rotated to "eight o'clock" (Fig. 36, 2), following interureteral ridge. 3. Cystoscope still further rotated. Ureter orifice in center of field but distant. Catheterism impossible. 4. Cystoscope moved toward ureter (Fig. 36, 3). Ureter large enough to catheterize. 5. Catheter in ureter.

To be in proper position for catheterism, the ureter should occupy approximately one fourth of the entire width of the cystoscopic field. The cystoscope should not be too near the ureter to blur the field of vision. When in position for catheterism it is as in Fig. 36 [3].

After the ureter has been found and is in position for catheterism, the technic is as follows, as described by Buerger.[1]

1. The ureteral opening is found and the ocular end of the cystoscope is brought slightly to the opposite side of the patient. By raising the shaft the ureteral slit is made to occupy a point just below the center of the field. *This position must be rigidly maintained during the next two steps.* It is best to get a picture of the ureter which is about the normal size; this is obtained when the objective is at a distance of 1 to $1\frac{1}{8}$ inches.

2. After the deflector has been slightly raised (just sufficient to prevent the catheter from hugging the lens) the catheter is pushed forward about 1 to 1.5 cm. beyond the limit of the field. Now the catheter appears enlarged, for it lies close to the prism.

3. The deviation is gradually increased by raising the deflector, the movement of the catheter in the field being observed during this procedure. The tip of the catheter now comes into view, first appearing at the bottom of the field and gradually traveling upward, its size diminishing at the same time. *When its tip is a short distance above the ureter, it is usually in the proper position;* in reality it then lies in front (nearer the neck of the bladder), above, and slightly to the inner side of the ureteral mouth.

4. By now raising the shaft of the instrument, and at the same time passing it farther into the bladder, the tip of the catheter is made to enter the mouth of the ureter. Therefore the cystoscope and the catheter as a whole travel toward the opening and not the catheter alone. When the catheter has engaged the ureteral opening it is pushed a short distance forward, the deflector is depressed somewhat, and, by still further raising the ocular, the introduction of the catheter becomes easy.

Various modifications of this method are indicated with abnormal placings of the ureteral orifices. For example, when the trigone is distorted by prostatic enlargement, the ideal position of the ureters in the cystoscopic field can only be approximated. These modifications can only be learned by experience.

Ureteral Catheterism with the Direct Cystoscope.—The interureteral ridge is not as distinctly seen with the direct cystoscope as with the prismatic. Starting with the cystoscope in the median line, the posterior boundary of the vascular trigone, the interureteral ridge is sought. If this is found, the ocular end of the cystoscope is moved

[1] (*Annals of Surgery,* February, 1909.) This description applies directly to the Brown-Buerger cystoscope, but the same technic is used with any prismatic catheterizing cystoscope.

laterally (away from the ureter to be catheterized) through an arc of 15 to 20 degrees, following the ridge. If the interureteral ridge cannot be plainly seen, the vesical end of the cystoscope is slowly swept over the area which the ureter should occupy until the ureter is seen.

When the ureter is found, it is generally easy to pass the catheter into it. Sometimes the ocular end of the cystoscope has to be considerably raised to accomplish this, especially if there be an enlargement of the median lobe of the prostate.

Unilateral or Bilateral Catheterism.—There are two methods of determining the condition of either kidney. First, by estimating the functional capacity. Second, by a study of the urine, especially microscopically. To accurately determine the functional capacity of the kidneys,[1] the total quantity of the urine excreted by either kidney is necessary and extra-catheter flow from either kidney must be excluded.

Also, there are different problems to be solved in different cases, viz.: 1. If the bladder is normal, is one of the two kidneys normal, and which one? 2. If the bladder is diseased, is one or both of the kidneys diseased?

To meet these conditions we have adopted the following procedure:

1. Bilateral catheterism is performed when it is suspected, from the symptoms or the appearance of the ureteral orifices, that both kidneys are affected; always in cases of bladder retention, as these are the cases in which bilateral infection is most apt to occur. Also when cystitis is present and it is desired to exclude the upper urinary tract as a source of the bladder infection.

2. Unilateral catheterism is performed if, on observation, one ureter is diseased and the other normal, the normal ureter being catheterized. If both ureters are apparently normal, the ureter is catheterized which corresponds to the side presumed normal from the symptoms.

When unilateral catheterism is performed, an Albarran catheter as large as the ureter can admit (generally 5, 6, or 7 F.) is introduced for a distance of 15 to 20 cm. When the ureteral catheter is in place 1 c.c.[2] of indigo-carmin solution is injected into the ureter catheter and allowed to flow out again. During this time (two to three minutes) the ureteral mouth is watched through the cystoscope, to observe if any blue appears alongside the catheter. If it does, a larger catheter is introduced. If not, the catheter-carrying telescope is first removed, and then the sheath and a bladder catheter is inserted. Thus we obtain all the urine from either kidney.

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[1] That is, as nearly accurately as is possible with our present methods.

[2] If too much fluid is injected it will leak by the catheter, whether there is normal extra-catheter flow or not.

Indications for Ureteral Catheterism.—1. All cases whose symptoms, physical signs, or urinary findings suggest surgical disease of the kidneys or ureters.

2. All cases of urinary tuberculosis.

3. All cases of intractable cystitis, to exclude the kidneys as the source of the infection.

4. Cases of suspected ureteral stone to ascertain the position of the stone; or to see if the ureter is permeable; or to dilate the ureter to facilitate the passage of a stone; or to indicate the position of the ureters in an X-ray picture.

Contra-indications to Ureteral Catheterism.—These are the same as for cystoscopy.

Dangers and Difficulties.—The danger always first mentioned with ureteral catheterism is infection of the ureter and kidney from the ureter catheter. I have never seen any case where I had reason to believe this had occurred. If, because of the condition of the patient, its possibility is suggested, either the normal appearing ureter should be catheterized (there being less danger of infection than if a catheter be introduced into the diseased ureter), or urinary separation should be performed. If ureteral catheterism is done, when the catheter is removed 5 to 10 c.c. of silver nitrate (1:1,000) should be injected as the catheter is withdrawn.

Urinary Separation

The instrument of Luys seems to be the only practical urinary separator.[1] I have used this instrument in a series of nearly fifty cases with entirely trustworthy results.

The Instrument.—The Luys instrument (see Fig. 38), when ready for introduction into the bladder (A), has the form of a Béniqué metal sound and corresponds to 21, French scale. The portion from *d* to *e* (A) is the intravesical part. The entire instrument may be separated into three portions, one central and two external. A long, slender glove-finger of rubber is fitted over the central portion, which in its intravesical part contains a fine chain. By a mechanism at *c* (A) the chain may be tightened and the rubber covering it put on the stretch, so forming a diaphragm which, when the instrument is in position, divides the bladder into halves (B). The lower portion of the rubber diaphragm comes in contact with the bladder wall at *f* (B). The two external portions of the separator are tubes through which the separated urine flows. These tubes have each three fenestrations on the side

[1] Having failed to obtain satisfactory results from the separators of Harris and of Cathelin, and having seen much better results with the Luys separator, I can warmly approve the above statement.—Keyes.

toward the rubber diaphragm, for the entrance of the urine from the ureters.

When the separator has been introduced and the diaphragm adjusted, the empty bladder, by virtue of its muscular action, grasps the

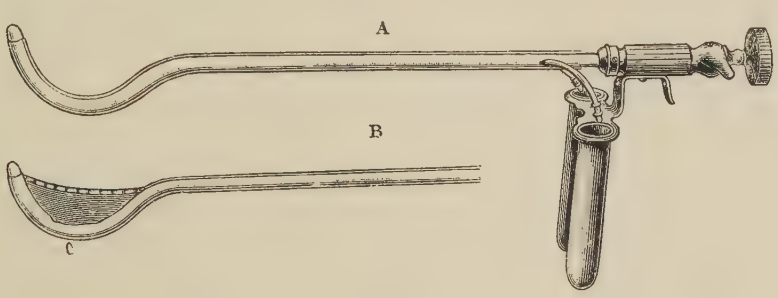

FIG. 38.—LUYS SEPARATOR. *A*. With diaphragm depressed for introduction and extraction. *B*. Diaphragm elevated as when instrument is in bladder.

separator, the right ureter emptying its urine on one side close to the diaphragm, and the left on the other side.

The child's separator is 17 F. in size, and has a slightly different curve.

Technic of Separation.—*The bladder should be cystoscoped, if possible, before the separation.* The separator is sterilized by boiling. It must be examined before using to see that both tubes of the separator are permeable; that their lumen is not narrowed by dirt, rust, etc. The rubber membrane must be examined for perforations both before and after using. The minimal bladder capacity in which I have used the separator is 50 c.c.

Introduction.—The separator having been sterilized, the urethra anesthetized, and genitals and bladder prepared under aseptic precautions, the patient is ready for its introduction. The patient should be in the position described for cystoscopy.[1]

With women the introduction is very simple and as a rule painless. The tip of the separator is inserted into the urethra as a sound or catheter, and the instrument, following the curve of the urethra, glides into the bladder. Vaginal palpation may be employed to verify its position, but I have seldom found this necessary.

With men the introduction is more difficult and more painful. The instrument is introduced into the male urethra in the same manner as a Béniqué sound until the tip is at the prostatic urethra. Then slowly and with much care the handle of the instrument is depressed, there being at the same time a constant and steady pressure along the axis of

[1] It is essential that the patient be in a semi-recumbent position. Otherwise the separation is not effectual.

the separator. With or without a slight jump the separator enters the bladder, whereupon the handle should be elevated.

The diaphragm should be adjusted and the handle of the separator gently raised until the intravesical portion meets resistance along the lower bladder wall. When the separation has been completed the diaphragm should be lowered and the instrument removed, reversing the steps of introduction.

With the separator in position the adjusting of the diaphragm causes little or no pain. If the separator is not entirely within the bladder, the elevation of the diaphragm causes trauma of the vesical sphincter. When this is the case much pain is usually caused by screwing up the diaphragm, and bleeding occurs and will become manifest in the urine that flows from the tubes of the separator.

Before the instrument is entirely within the bladder, fluid begins to run irregularly from the tubes.

It has been my custom to stop the flow of boric solution from the tubes until the separator is wholly within the bladder and the diaphragm adjusted, these manipulations being less likely to cause trauma to the mucous membrane if fluid be within the bladder.

Indications for Urinary Separation.—1. In those cases where the ureteral orifices are obscured by cystitis, or in which the rapid excretion of pus or blood into the bladder clouds the bladder fluid and so prevents ureteral catheterism.

2. In those rare cases where infection from a ureteral catheter is feared.

3. In children.

Contra-indications.—1. Those cases in which the bladder capacity is less than 20 to 30 c.c.

2. Cases where the base or neck of the bladder is distorted by marked prostatic hypertrophy; extreme anteversion or anteflexion of the uterus; certain uterine tumors; marked cystocele.

3. Cases in which the urethra is not penetrable to the instrument. These include cases in the male, where the rigid or contracted bladder neck prevents the introduction of the separator.

4. Those cases where an extended examination of the functional kidney capacity, as, e. g., experimental polyuria, is desired.

5. *The presence of cystitis is not a contra-indication* to urinary separation. In these cases all of the urine is obtained from either kidney, from which an estimate of the functional capacity may be obtained. In a series of cases, in which cystitis was present, the microscopical examination of the separated specimens gave an exact index of the condition found at operation.

OTHER METHODS OF EXAMINATION

If cystoscopy, ureteral catheterism, and urinary separation all fail there are still other methods of much value in determining which kidney is diseased and the extent of the disease. These in order of their value may be classified as follows:

1. Methods to determine the functional capacity of both kidneys.
2. Radiography.
3. Palpation of both kidneys at operation.

"Renal palpatory albuminuria" should not be included in this class, as it is of no worth.

1. **Functional Activity of Both Kidneys.**—Methods to determine the functional capacity of both kidneys acting as a unit. (See Chapter VI.

(*a*) Any one of the *qualitative methods* to determine the kidney capacity may be used, and a catheter introduced into the bladder. Such are phloridzin and indigo carmin. The time which it takes to excrete either of these substances into the bladder corresponds to the time that the least diseased of the two kidneys can excrete the substance. Therefore, if sugar be excreted in normal time after phloridzin injection (say twenty minutes), this suggests that one of the kidneys is working normally. If the time of excretion be retarded to forty, fifty, sixty minutes or more we have to resort to other methods.

(*b*) *Quantitative tests* are "experimental polyuria," and possibly the accurate measuring of the twenty-four-hour intake and excretion of nitrogen. (See Chapter VI.)

When these qualitative or quantitative methods have been used we get an idea of the work the better of the two kidneys is performing, and whether it, alone, can stand nephrectomy of its fellow, and will take up the body work after the removal of the diseased kidney.

Having gained this, the symptoms or physical signs may indicate which kidney is diseased. If not, we have to turn to radiography or palpation of both kidneys at operation.

2. **Radiography.**—A good radiograph *may* definitely indicate which kidney is the site of pyonephrosis, or contains a stone. Slight kidney affections, unless calculous, are not shown by radiography.

3. **Palpation of the kidneys at the time of operation** may reveal the presence of two kidneys, but not the degree of involvement, and often not even which one is diseased. If one kidney is a mere pus sack, this can generally be made out by palpation. This procedure should be used only as a last resort when all others fail, and only to indicate that two kidneys are present.

THE NORMAL BLADDER

The capacity of the normal bladder, male or female, is about 250 c.c. The trigone of the normal bladder is fixed, distention of the bladder having no effect upon its position. Because of this an excellent view of the ureteral orifices may be obtained, even if the bladder contains a very small amount of fluid. In contrast to this, examination of the vault of a bladder in which there is a small amount of fluid is difficult.

Upon introducing the prismatic cystoscope the vault of the bladder is first examined. At the apex of the bladder is often seen an air bubble, the air having been introduced during the bladder irrigation. This must not be mistaken for a tumor mass or other pathological formation. The cystoscope is now withdrawn until the bladder sphincter is reached, and the urethral orifice is seen. The lateral walls are examined, and finally the bas fond and the ureteral orifices.

In a normal bladder the ureteral orifices are almost always exactly opposite each other and are seen at the extremities of the interureteral ridge, with the cystoscope pointing to about "four o'clock" (left ureter) and "eight o'clock" (right ureter) respectively. If the right ureter is found, for example, its fellow may be found in a majority of instances by simply turning the beak of the cystoscope as many degrees to the left of the median line as it was to the right.

With patience almost all of the bladder may be examined.[1] But a small part of the trigone, the posterior, can be examined with the prismatic cystoscope.

The mucous membrane of a normal bladder is yellowish-gray in color and the blood vessels may be seen, red and distinct. In the reddish trigone there are many vessels which, appearing in any other part of the bladder, would indicate acute congestion.

THE ABNORMAL BLADDER

Under this heading will be discussed abnormalities in conformation. Abnormalities as regards inflammation, tumors, etc., will be discussed under their respective headings.

Male.—1. **Ureters.**—The trigone with the ureters at either angle maintain an almost mathematically fixed position in the majority of cases. This position is well shown in Figs. 36 and 37. The most frequent cause of distortion of the trigone and ureteral orifices is enlargement of the prostate. This may be but a moderate median lobe enlargement, as in

[1] That part of the bladder base directly opposite the urethra cannot be seen by the prismatic cystoscope. But nothing of importance is to be seen in this region except tumor. Unless tumor is suspected, therefore, complete examination requires only a prismatic instrument.

Pl. III, where the position of the interureteral bar is taken by the enlarged median lobe (not really, but as seen cystoscopically); or the prostatic enlargement may be so decided and irregular as to entirely distort the relative position of the ureters, even to the point of wholly obscuring them.

An advanced tuberculous process of one ureter may cause considerable retraction of that ureter and pull the whole trigone to one side. The ureters are found, however, on the interureteral ridge.

Abnormal implantations of the ureter orifices are nearly always found in relation to the interureteral ridge. If there is a double ureter the second member terminates in the trigone between the normal orifice and the urethra.

2. **Prostatic Enlargement.**—The only way to determine accurately the intravesical prostatic enlargement is by the cystoscope. Young has perfected this method. Often when no rectal enlargement is felt in a patient giving symptoms of prostatism, the cystoscope will reveal prostatic enlargement, intravesically (Pl. III).

3. **Tumors and Inflammatory Conditions, External to the Bladder.**—These conditions may cause depressions of the bladder, and if they are attached to the bladder may cause circulatory changes in the bladder wall, such as swelling of the mucous membrane, hemorrhagic areas, varicosities of the vessels, bullous edema, or tumor formation of the bladder itself. These circulatory changes may be of considerable importance in diagnosing whether a tumor mass external to the bladder is really attached to the bladder wall. The changes are, however, so like those appearing with simple inflammatory conditions of the bladder that care has to be used in making such a diagnosis. Pl. I, Fig. 4, shows the cystoscopic appearance of a uterine carcinoma depressing the bladder wall.

Female.—Abnormalities in conformation of the female bladder are discussed in Chapter XLVIII.

CHAPTER VI

ESTIMATION OF THE RENAL FUNCTION

Study of the excretory activity of the kidneys in order to detect impairment of this function is the chief object of every urinalysis, whether by the urologist or by the general practitioner. Estimation of the quantity of urine for twenty-four hours, of the urea or nitrogen output, of the specific gravity, taken in connection with analysis for sugar and albumin, and microscopic examination of the centrifuged sediment, form the usual basis for this study. But although these familiar tests usually show whether or not the kidneys are diseased and whether their function is impaired, they may often mislead both from an anatomical and from a physiological point of view. R. Cabot's investigations at the Massachusetts General Hospital illustrate the fact that many patients die with interstitial or parenchymatous nephritis who, during life, showed few or none of the urinary changes considered characteristic of these diseases.

But although such uncertainties are of peculiar interest to the urologist, his complaint is not quite that of the general practitioner. The kidney in urology is the kidney injured by retention or by infection; the *fact* of renal disease is in most of these cases evident enough, but the *extent and distribution* of the disease are ascertained with difficulty.

Are both kidneys diseased? If nephrectomy is contemplated, will the remaining kidney be adequate to sustain life? Does a given pain arise in the kidney or in some adjoining viscus? These questions illustrate the special requirements of the urologist and demand:

I. Examination of the urines obtained separately from the two kidneys, and

II. Estimation, from this examination, of the functional capacity of each kidney—(*a*) whether it is absent or present; (*b*) whether its function is impaired at all, (*c*) or whether this is so impaired that in the event of nephrectomy the patient would die through insufficiency of the remaining kidney.

The urines from the two kidneys may be separated by ureteral catheterization or by one of the so-called separators or segregators. The comparative merits of these instruments have been discussed in Chapter V.

Estimation of the functional capacity of each kidney from the urine thus obtained, to be accurate, must be founded upon a knowledge of the

general principles not only of urology and renal pathology, but also upon an appreciation of the physiologic and pathologic variations of the renal function, and especially the changes that may be accidentally or intentionally induced in it by examination.

PHYSIOLOGIC AND PATHOLOGIC CHANGES IN THE RENAL FUNCTION

Physiologic Variations.—So incessant are the physiologic variations in quantity and quality of the urine that examination of a given specimen gives no clew to the nature of the total "twenty-four-hours' urine." This accepted axiom is preëminently applicable to specimens obtained by the ureter catheter. One cannot infer from them, in any but the most general way, the average amount or quality of the urine.

The result of these physiologic variations is, generally speaking, either increase in specific gravity and contained solids (urea, chlorids, etc.), with a corresponding decrease in quantity, or a decrease in density with a corresponding increase in quantity. In other words, the variation is one of dilution more than anything else; the solids vary little, the water much. Yet the ratio is not absolute; the solids, though varying less than the water, do vary to an indeterminate degree.

The causes of these variations are innumerable. The chief ones may be classified as follows:

Causes of Concentration.—Heat, exercise, fever, starvation, and especially deprivation of water.

Causes of Dilution.—Drinking (especially of alcohol), eating, and various irritations of the nervous system (e. g., hysterical polyuria).

The following table expresses roughly the average urinary output of a healthy adult man in twenty-four hours. This corresponds to a urea output of 25 or 30 gm. a day. But wide physiologic variations from this average are possible. The daily average of urea excreted by a healthy person may even fall as low as 10 or 12 gm. for short periods and in exceptional instances.

Women excrete rather less urea and often much less water than men.

Normal Twenty-four-Hour Urinary Output

Quantity	Density
3,000 c.c.	1.009
2,500 c.c.	1.011
2,000 c.c.	1.013
1,700 c.c.	1.016
1,500 c.c.	1.018
1,350 c.c.	1.020
1,250 c.c.	1.022
1,100 c.c.	1.025
1,000 c.c.	1.027
900 c.c.	1.030

Pathologic Variations.—Each disease and diathesis has its influence upon the excretion of the kidneys. But we are interested only in those variations in the composition of the urine induced by disease of the kidney itself, and this only in a restricted sense. We are not for the moment studying the abnormal constituents (crystals, pus, etc.) found in the urine from a diseased kidney, but only the variation in the functional capacity, the ability to excrete water and solids, of such a kidney.

The pathological variations thus to be considered are:

(1) Effect of destruction of or disease in one kidney upon its healthy fellow.

(2) Effect upon the function of a kidney of disease in itself.

Effect of Destruction of or Disease in the Opposite Kidney.—Two conditions are possible: the kidney may be completely destroyed by disease (or removed by operation), or it may be the seat of active disease.

The effect of destruction or removal of one kidney is to require an excess of work from the other. If life is to continue, the remaining kidney must take up this work. Consequently it hypertrophies. The glomeruli increase in size, the epithelia of the tubules hypertrophy, the kidney as a whole grows much larger, the secretion of the single kidney soon becomes equivalent both in solids and in water to that of two normal kidneys. Yet there is no new formation of glomeruli, of tubules, or of epithelium.[1]

On the other hand, while *the effect of disease in one kidney* is primarily to place upon the other an extra burden of excretion and to excite in it a sufficient hypertrophy to compensate for the excretory power lost by the diseased organ, this tendency to hypertrophy may be markedly impaired by the call upon the healthy kidney to excrete not only the normal excretory products which its fellow cannot care for, but also the abnormal products of the disease in its fellow. This impairment is most marked in cases of suppurative nephritis (pyelonephritis, tuberculosis, etc.).

In such diseases we endeavor by nephrotomy or nephrectomy not only to check the disease in the inflamed kidney, not only to prevent any further absorption of toxic products from it, but also to relieve the healthy kidney of the necessity of eliminating these products, and of the danger of being overwhelmed by them.

The phenomenon of *toxic inhibition of a normal kidney* is most strikingly illustrated by the so-called "reflex anuria" (p. 431) (though in this instance the "normal" kidney is never quite absolutely normal). But the same phenomenon may be observed by means of ureteral catheterization before and after almost any nephrotomy or nephrectomy suc-

[1] The opposite theory maintained by Tillmanns and Tuffier was disproved by Albarran (*Presse méd.*, 1899).

cessfully performed for renal suppuration. As soon as the healthy organ rallies from the depression following anesthesia it proceeds to excrete more and more solids; i. e., its functional activity becomes greater and greater, and this rally is proportional to the relief afforded by drainage or removal of its fellow.

Effect upon the Function of a Kidney from Disease within Itself.—Disease in a kidney affects the organ in two distinct ways:

(1) The disease impairs function by destroying the parenchyma. Thus it is well known that interstitial nephritis may exist for many years and yet impair the function of the kidney only slightly, if at all, while parenchymatous nephritis promptly and gravely impairs renal activity. Now the nephritis due to pathogenic microörganisms is both interstitial and parenchymatous; but, inasmuch as it always destroys parenchyma to a greater or less degree, the important lesions of microbic nephritis are the parenchymatous lesions: surgical nephritis is parenchymatous nephritis in its effect upon the renal function.

(2) Upon the remaining parenchyma, upon that part of the kidney—namely, that is not diseased, the effect of the nephritis is precisely the same as though the inflammation were in the opposite kidney. The function of the parenchyma is somewhat inhibited by the effort to transmit the poisons elaborated in the diseased portions of the organ, and at the same time there is a tendency to compensatory hypertrophy of the epithelium and of the glomeruli quite as marked as though the disease were upon the other side.

As a result of these conditions the diseased kidney is, as it were, constantly striving to keep up to the demand upon its capacity. Instead of working calmly and quietly most of the time and working especially hard when called upon by some physiologic strain (e. g., food or drink), it is always straining with its impaired equipment to take its share in a task of exertion calculated to impair (temporarily, at least) the function of a fully equipped, normal kidney.

Clinically, therefore, the diseased kidney does less work and shows less resiliency than its normal fellow. It reacts less than its fellow to the normal physiologic stimuli. Its output is relatively insufficient and relatively constant. *The more widespread the destruction of parenchyma the more constant does the urinary output remain.*

Hence the integrity of function and of parenchyma in a kidney may be measured not alone by its excretion of solids, but also by its response to physiologic stimuli. *When the function of one kidney is impaired and that of its fellow unimpaired, the physiologic variations in the quantity and quality of the total urine occur chiefly in the urine from the sound kidney*, and, further, the constancy of the excretion of a kidney under physiologic stimulation is a measure of the impairment of its function.

Thus, if the urine from the two kidneys is separated by ureteral catheterism, and while the catheters are in place, the kidneys are stimulated (e. g., by the drinking of several glasses of water), the resultant changes in the urine will appear chiefly in the urine of the normal, or more normal, kidney, and the lack of variation in either or in both kidneys is an index to the impairment of the renal function.

These important clinical deductions were first fully worked out by Albarran.[1]

They have been verified by a number of reports,[2] and even Kapsammer,[3] who seriously questions their applicability in practice, admits that reflex polyuria (p. 74), the most confusing element, occurs chiefly in kidneys the seat of compensatory hypertrophy; i. e., in relatively normal kidneys.

DURATION OF AND ESSENTIAL PRELIMINARIES TO THE EXAMINATION

Duration.—From the preceding observations it might seem that in a given space of time two entirely normal kidneys should excrete urine precisely similar both in quantity and in quality. But physiologic laws defy mathematics, and although in the long run two normal kidneys do perform exactly the same amount of work, they accomplish this in an intermittent and irregular way. Animal experiments and ureter catheterism show that in several senses there is alternation in ureteral peristalsis. The drip from the ureteral catheters is usually alternate on the two sides; one side may stop working for a time, while the other drips rapidly; or the drip from one side may be much slower than that from the other. These irregularities of function are so marked during the first ten minutes of the examination (owing to reflex disturbance by the passage of cystoscope and catheter) that it is customary to disregard the urine passed during this interval in quantitative estimations. But thereafter, if the kidneys be normal, the urinary output of the two kidneys, though irregular and unequal in ten- or fifteen-minute intervals, compensates in the succeeding few minutes, so that if we estimate the urine by twenty- or thirty-minute intervals the output is almost equivalent on the two sides, and the longer the interval the more precise this equivalence.

Albarran has shown that in the first half hour variations in quantity of urine excreted simultaneously by two normal kidneys often reach 10

[1] They are discussed in his "Explorations des fonctions rénales," Paris, 1905, the most brilliant and complete exposition of this subject yet published.

[2] Von Illyes and Kovesi, *Berl. klin. Wochenschr.*, April 7, 1902; Strauss, *Münch. med. Wochenschr.*, 1903; Nicolaysen, *Norsk Mag. f. Laegevidenskaben*, 1906, No. 11.

[3] *Nierenchirurgie*, i, 1907.

per cent to 30 per cent, but if the urine is collected for an hour the variation falls within 10 per cent. Similarly, the difference in simultaneous urea excretion may reach 6.45 gm. per liter in fifteen minutes (though this is in large measure compensated by the difference in the quality of urine excreted, the polyuria being naturally associated with a low proportion of solids), but is much less in longer periods.

For this reason Albarran insists that, in order adequately to estimate the function of each kidney, the catheters must remain in place at least two hours.

So prolonged a catheterism is unnecessary in most instances, though occasionally required in doubtful "border line" cases.

Subsequent investigations collated and confirmed by Kapsammer go to show that ureter catheterism of from thirty to sixty minutes suffices in almost every instance.

Preliminaries.—In order to eliminate artificial and physiologic variations from the urine excreted by the two kidneys, certain preliminaries to ureter catheterism must be observed:

The kidneys must not be palpated before the test. Schreiber [1] found that the kidneys show distinct though transitory evidence of traumatism after palpation. Thus he observed transitory albuminuria (reaching in one instance 3 per cent by volume), beginning within ten minutes and usually ceasing within two hours in 39 out of 42 patients whose kidneys he palpated. Hence, the kidneys should not be palpated within the two hours before examination, and it is preferable that at least twenty-four hours should intervene.

The patient should neither eat nor drink anything for two or more hours before the test. Albarran's curves show very plainly the prompt polyuria that follows a meal and lasts for several hours thereafter. He also shows a sharp rise in the amount of urine excreted immediately after drinking a few glasses of water. This polyuria disappears within two hours. The patient should therefore neither eat nor drink *anything* for at least two hours before the test.

A twenty-four-hour specimen should be collected and analyzed immediately before the test. The reason for this is obvious.

VARIATIONS INDUCED BY THE EXAMINATION

Even the beginner is impressed by the fact that immediately after introduction of a ureteral catheter the urinary excretion is, for a few minutes, likely to be extremely slow. This reflex inhibition of the kid-

[1] *Zeitschr. f. klin. Med.*, 1904, lv, 55. Morano (*Gaz. degli Osp.*, 1903, xxix) and Zhehofski (*Roussky Vratch*, November 11, 1906) have made similar observations. The latter finds a parallel between the resulting albuminuria and the condition of the kidney.

ney function does not, however, last more than five or ten minutes as a rule; thereafter the urine issues at what may be considered a normal rate.

But exceptionally there may be prolonged reflex anuria or oliguria, or this may give place to polyuria.

Reflex Oliguria or Anuria.—This is not often a disturbing factor.[1] Anuria from a normal kidney never lasts more than ten minutes and oliguria scarcely longer. But our examinations are habitually made upon abnormal kidneys, and these, very exceptionally, may show anuria or oliguria of much greater duration. Indeed, I was once misled in a case of suspected renal tuberculosis by a total anuria lasting half an hour (the patency of the catheter having been assured by the reflux of injected fluid) into the assumption that there was a closed pyonephrosis on the right side. But exploration, though it revealed a right kidney the seat of chronic nephritis with a conjested and slightly dilated pelvis, revealed no recognizable tubercular lesions (a section of renal tissue showed only interstitial and parenchymatous nephritis), and the issue of blood with the bladder urine for several days after the operation confirmed the belief that the ureter was patent. I know of no other instance of such prolonged reflex catheteral anuria even from a diseased kidney.

That the urine segregator causes a more marked anuria than the ureteral catheter (as alleged by Albarran) I do not believe.[2] Slight variations may result from either instrumentation. A catheter introduced into one ureter may affect the function of the opposite kidney.

Reflex Polyuria.—The reflex polyuria excited by the ureter catheter is an important and, to some extent, an undetermined factor in the estimation of renal function. Kapsammer has repeatedly insisted that this polyuria is so common and so abundant as to distort any quantitative analysis. Thus he states that "variations in the secretion of urine excited by the ureter catheter concern chiefly the excretion of water; the excretion of solids varies little, if at all. Since, therefore, reflex polyuria implies only an increased output of water, the output of solids remaining undisturbed, difficulties arise in the interpretation of the functional activity of the kidneys that markedly impair the value of certain (quantitative) methods of examination."

Our own observations lead us to believe that although the variation in excretion during catheterism is such that from the urine obtained in one or two hours by ureteral catheter it is impossible accurately to estimate the twenty-four-hour output either of fluids or of solids, this is due

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[1] If the urine obtained during the first ten or fifteen minutes is discarded.

[2] Cf. Barringer, *Surgery, Gyn. and Obstet.*, Dec., 1908, p. 651.

rather to physiological than to catheteral variations. We have already noted the increase in the amount of water excreted after a meal or even after a drink of water, and the "hysterical polyuria" that afflicts many persons in moments of excitement has long been recognized. To these two factors, rather than to any special polyuria induced by the ureter catheter, we attribute such variations as we have seen.[1]

Experimental Polyuria.—A most important field has been opened by Albarran's study of the difference between the action of a healthy and a functionally (and anatomically) impaired kidney.

To quote his own words: "When only one of the kidneys is diseased, or one is diseased more than the other, disturbances of the urinary function influence its excretion less than that of its fellow, so that the disparity in excretion is accentuated chiefly by variations in the excretion of the healthy kidney." By artificially stimulating the renal function he makes this fact, the nature of which we have studied in the preceding paragraphs, a basis for his "experimental polyuria" test of renal function.

THE TESTS OF URINARY FUNCTION

It were a waste of time to enumerate and discuss all the various methods that have been employed in the effort to determine the relative capacity of each kidney through analysis of the urine drawn by ureteral catheter or urine segregator. The greater number have passed from current practice, and undoubtedly some that remain will not find favor a decade from now. We may therefore confine our attention to those tests that enjoy some repute at present. These we may group in four classes, viz.:

I. Routine Urinalysis—Quantity.
Quality.
Albumin.
Microscopic analysis.

II. Normal Urinary Elimination—Specific gravity.
Freezing point (of the urine and of the blood).
Urea and nitrogen.
Chlorids.

III. Elimination of Drugs—Methylene blue.
Phloridzin.
Indigo carmin (Chromocystoscopy).

IV. Artificial Urinary Elimination—Experimental polyuria.

[1] Perhaps the fact that Kapsammer considers it essential to keep the cystoscope in place and the bladder distended with fluid throughout the examination makes reflex polyuria more marked in his cases.

We shall take up each test in turn, describing the technic when this is unfamiliar, and briefly noting its probable advantages and disadvantages.

Every specimen obtained by ureteral catheter must be put through a certain routine analysis. The least that can be done is to note its quantity, its urea content, its albumin content, and the cellular and crystalline substances mingled with it.

The necessity for an albumin test and a microscopic examination is obvious. These tests have no direct bearing upon the question of renal function, but are essential to a correct diagnosis of the nature of the renal lesion.

In the majority of instances the equation between quantity and density of the urine excreted by the two kidneys suffices without any further test to indicate which kidney is the more diseased. Thus we often find that one kidney either eliminates no urine at all, or eliminates urine markedly inferior both in quantity and quality to that of its fellow. But there is often question, especially if nephrectomy is contemplated, of the quality of the sounder kidney. It may be the better of the two and yet incapable of supporting the total task of elimination unaided by its weaker fellow. Moreover, in a large minority of cases the mere analysis of quantity and density may be confusing or misleading by revealing, for example, a large quantity of dilute urine from one kidney and a small quantity of dense urine from the other, a condition requiring further investigation to explain its cause.

Quantity

The average quantity of urine excreted in one hour by each normal kidney is about 30 c.c., but the "normal" excretion of water by a healthy kidney varies even more widely than the "normal" pulse rate. For five or ten minutes, it may cease altogether; indeed, neurologists report instances of hysterical anuria of several days' duration, but such freaks need not be considered in routine work.

The duration of anuria up to ten minutes in a healthy kidney and up to half an hour in a diseased kidney may be due to purely functional causes. If anuria lasts more than ten minutes we may conclude that the kidney is diseased; if more than half an hour, that it is not functionating.

When both kidneys are normal, oliguria, i. e., a marked diminution in the output of one kidney as compared to the other, does not usually last more than half an hour, and is compensated for by polyuria during the second half hour. Marked and persistent, oliguria on one side (less than 10 c.c. an hour) is, in our experience, always associated with other evidences of disease in that kidney. Such marked oliguria we have not seen in any normal case.

Polyuria, when not due to eating or drinking, may be reflex (p. 74) or due to disease. While it is the general rule that a diseased kidney secretes less urine than its normal or more normal fellow, there are notable exceptions to this rule. Constant, unvarying oliguria on the diseased side, even under the experimental polyuria test, means that practically the whole parenchyma of the kidney is diseased. In such grave maladies as hydronephrosis, pyelonephritis (whether calculous or not), neoplasm, and tuberculosis, the affected kidney may still contain large areas of normal or even of hypertrophied parenchyma. Such a kidney is subject, in some measure, at least, to reflex or experimental polyuria, and it may well be that irritation of the renal pelvis by inflammation (pyelonephritis, tuberculosis), stone, or pressure (hydronephrosis, nephroptosis), or by the presence of the ureter catheter, may excite polyuria from the diseased kidney at the time of the examination.

Thus, among 108 examinations Albarran found relative polyuria on the sound side 60 times, on the diseased side 35 times, while the quantity was equal 8 times and varied (sometimes more on one side, sometimes more on the other) 5 times. He adds: "Polyuria of the sound kidney, compared to the secretion of the diseased kidney, is habitually very considerable when the latter is gravely diseased. It is noteworthy, however, that in pyelonephritis and renal tuberculosis a kidney the seat of marked lesions may secrete about as much urine as its fellow. When the lesion is not a grave one, polyuria of the sound kidney is less marked, and may even be replaced by polyuria of the diseased kidney."

Quality

In every branch of medicine the generally accepted method of determining the quality of the urine and the activity of the kidney function is the urea test.

The specific gravity is, to be sure, the actual test of density; but, apart from the fact that the specific gravity measures the urinary density as influenced by various adventitious elements (albumin, glucose), and therefore cannot be employed in connection with the artificial elimination tests, the difficulty of obtaining sufficient urine in a given ureter catheter specimen to float a ureometer considerably restricts the applicability of this test. The various total and differential nitrogen tests have not yet been proven sufficiently superior to amend for the complexity of their technic. The quantitative estimation of urinary chlorids is generally acknowledged to be a method inferior to the urea estimation.

Of the remaining methods of estimating the quality of the renal function, four will especially engage our attention, viz., cryoscopy, the phloridzin test, chromocystoscopy, and the experimental polyuria test. The methylene-blue test has, on account of its complications, been quite

replaced by the phloridzin test. Even Albarran, the champion of the blue test, states that "comparative study of the elimination of methylene blue by the two kidneys is of real practical importance only in exceptional instances."

Cryoscopy

The determination of the temperature at which a fluid freezes is entitled cryoscopy. This temperature is called the "freezing point," and is symbolized by the letter △.

Method of Estimating the Freezing Point of the Blood.— The blood is drawn by venesection or by scarification and cupping. The △ of the serum obtained by cupping is 0.02° or 0.03° C. lower than the true △. This difference is overcome by passing a stream of oxygen through the serum for about five minutes.

About 5 c.c. of serum is required for the test. If obtained by cupping, enough may usually be had from three cups.

The cryoscopic apparatus consists of a jar, to be filled with ice and salt, in the midst of which is set a tube containing equal parts of glycerin and water (a mixture that remains fluid below 0° C.). Within this tube is suspended a still smaller tube to receive the fluid whose △ is to be tested, and in which is placed a thermometer, graduated to every hundredth of a degree Centigrade, and surrounded by a platinum spiral, with a long handle, to be used for the purpose of agitating the fluid.

The jar is filled with salt and ice, the outer tube with glycerin and water, the inner tube with enough serum to cover fully the bulb of the thermometer. The thermometer bulb is sunk into the serum. As the level of the mercury falls toward 0° C., the fluid must be constantly agitated until its temperature has fallen well below the probable freezing point. Then the thermometer is held still and a sliver of ice dropped into the serum to hasten freezing. The mercury promptly rises to a maximum, which it holds for a moment before falling again and freezing. *The momentary maximum is the freezing point.*

The accuracy of the thermometer should be tested in water each time it is to be used.

Method of Estimating the Freezing Point of Urine.— This is precisely the same as the maneuver described above, except that urine is poured into the inner tube instead of blood serum.

Object of Cryoscopy.— The △ of a solution varies inversely with its concentration. The greater the concentration, the lower the △. Thus watery solutions have a △ below 0° C. The △ varies inversely to the specific gravity, for the former measures the number of molecules in a solution, while the latter measures their weight. The higher the specific gravity the lower the freezing point.

Why, then, should we, as practical urologists, bother about the freezing point?

To answer this question requires a brief review of the history of cryoscopy as a test of urinary function.

Disadvantage of Cryoscopy of the Blood.—Cryoscopy as a test of renal function was first employed by Koranyi.[1] He noted the △ of the blood serum alone and in connection with the urinary △. Kummell and Rumpel[2] have published the most extensive study yet made of the importance of the △ of the blood and urine in clinical urology. Their conclusions are:

1. When the kidneys are normal the freezing point of the blood remains constant at $-0.56°$ C.

2. A bilateral kidney lesion increases the concentration of the blood (lowers the △) and correspondingly diminishes the concentration of the urine (elevates the △).

3. A unilateral renal lesion does not disturb the concentration of the blood.

4. When the △ of the blood falls below $-0.6°$ C., the function of both kidneys is so impaired as to prohibit nephrectomy.

While the general accuracy of these conclusions is conceded, their precise clinical applicability has been abundantly disproven. Thus Israel cites a case whose serum △ was $0.55°$ C., although one kidney was destroyed and the other pyenephrotic. Wiebrecht has seen a case with a single kidney almost completely destroyed by tuberculosis and a serum △ of $-0.56°$ C.[3]

On the other hand, Koranyi himself has reported a case of unilateral pyonephrosis whose blood △ was $-0.68°$ C. before nephrectomy and $-0.57°$ C. thereafter.

Hence a normal blood △ is *no absolute proof of renal sufficiency, nor is a* △ *of* $-0.60°$ C. *a contraindication to nephrectomy.* Indeed, cryoscopy of the blood has failed to prove of real assistance in urology.

Koranyi's Theory of Urinary Cryoscopy.—According to Koranyi, the glomeruli filter from the blood, a solution of sodium chlorid which passes into the canaliculi, there to undergo two changes. It becomes more concentrated by resorption of some of its water, and it gives up to the blood sodium chlorid in exchange for the organic urinary solids. This exchange is supposed to take place molecule for molecule.

The temerity of reducing physiologic processes to mathematical formulæ is admirably exemplified here. Koranyi's theory fits in with many accepted beliefs, but it does not stand the test of experiment. Ac-

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[1] *Berl. klin. Wochenschr.*, 1889, p. 97.

[2] *Beiträge z. klin. Chr.*, 1903, XXXVII, 788.

[3] Cf. also Beer, *Am. J. Med. Sci.*, Feb. 1906.

cording to it, other things being equal, the urine containing the most organic solids contains the least sodium chlorid. But Albarran, by ureter-catheter comparison of the urines from the two kidneys of healthy persons, has shown that exceptions to this rule are about as numerous as examples of its accuracy (9 cases for to 7 against).

Cryoscopy in Current Urologic Practice.[1]—The Koranyi formula $\frac{\triangle}{NaCl}$ is no longer studied, and the more complex formulæ of Claude and Balthazard, of Claude and Mautier, and of Tessier have not achieved even a temporary popularity. All that has survived is the simple $\triangle$ and the quantitative $\triangle$ volume (p. 82). There is no evidence to prove that these offer any advantage over Urea and U V, or over Sp. Gr. and Sp. Gr. V except by way of cumulative evidence.

The normal urinary $\triangle = -1.2°$ to $-1.6°$ C., but varies widely.

The Phloridzin Test

Technic.—A solution of phloridzin is injected under the skin. Caspar injects 1 c.c. of a 0.5-per-cent solution (containing 5 mgm. of phloridzin). Albarran believes it necessary to inject 4 c.c. (2 cgm. of phloridzin). Kapsammer injects 1 c.c. of a 1-per-cent solution. I have always employed this dose. To avoid precipitation it is necessary either to add 33 per cent of alcohol or to warm the liquid before using it. The solution is sterilized by boiling.

If the kidneys are normal they begin, in fifteen to thirty minutes after the injection, to eliminate glucose and continue to do so for from two to four hours thereafter. If the kidneys are diseased, the elimination of sugar is either delayed and slight or absent. Such is the general rule; the exceptions we shall note later.

The only essential condition to the test is that there be no pathologic glycosuria present at the time it is made. The administration of antipyrin, jambul, or the salicylates delays and diminishes phloridzin glycosuria, while repetition of the test induces an increased reaction.

Theory of Phloridzin Glycosuria.—After the injection of 5 mgm. of phloridzin the normal kidneys habitually excrete 1 to 2 gm. of glucose. That so great an amount of glucose cannot come from decomposition of the phloridzin injected is self-evident. That the glucose is formed chiefly, if not wholly, in the kidney has been proven by the in-

[1] An excellent description of cryoscopy may be found in *Boston Med. and Surg. J.*, December 4, 1902 (Bailey) and in *Phila. Med. J.*, March 21, 1903 (Grim). Recent original publications attacking cryoscopy have appeared in *Wien. klin. Wochenschr.*, 1904 (Kapsammer); *Arch. f. klin. Chir.*, 1906, LXXIX, No. 3 (Clairmont); *Beitr. f. klin. Med.*, 1908, LXVI, No. 4 (Steensma).

jection of phloridzin into the vessels of an isolated kidney. Hence phloridzin glycosuria has been taken as an index of kidney function. Caspar, Kapsammer, and others see in this test the ideal evidence of the capacity of the renal epithelia to functionate.

Phloridzin in Urology.—The phloridzin test of urinary function, though first studied by Achard in 1899, was first applied to the study of surgical renal disease by Caspar and Richter in 1901. These authors draw their conclusions from comparative tests of the quantity of glucose contained in the urines simultaneously obtained from the two kidneys by ureter catheter at intervals of ten minutes. They take no account of the quantity of sugar eliminated or of the duration of the elimination, but only of its onset and its comparative intensity at a given moment. (Indeed, a clinical study of the total elimination of sugar and of the duration of the process in each kidney is often impracticable.)

Confirmation of the observations of Caspar rapidly accumulated from all sides, and the phloridzin test is firmly established as the best "artificial elimination" test [1] we possess. But its findings may be misleading. It is very sensitive to many disturbing influences, some known, some unknown, and while it is almost without exception true that an early (twenty minutes) and generous output of sugar guarantees the soundness of a kidney, it is not true that a retarded (45-minute) glycosuria proves real impairment of the kidney function. Beer has recently published a number of brilliant examples of the effect of disease in the opposite kidney in retarding glycosuria of the normal kidney.[2] I have successfully performed nephrectomy upon a patient whose total urine showed no sugar until two hours after injection.

In short, phloridzin does not mislead as to the side of the lesion, for *the kidney whose glycosuria is the more delayed or feeble is always the more diseased;* but it does mislead as to the extent of disease in either kidney, since nephrectomy has been successfully performed in the face of total bilateral absence of glycosuria. On the other hand, an early full onset of glycosuria is excellent though not infallible testimony to the soundness of the kidney.[3]

Chromocystoscopy

Technic.—Four c.c. of a 4-per-cent suspension of indigo carmin (indigo sulphate of sodium) are injected *into the muscle* of the buttock.

[1] I. e., a test of the renal excretion of some substance artificially introduced into the circulation.

[2] *Jour. Am. Med. Assoc.*, June 13, 1908, p. 1972.

[3] Lenk, *Wien. klin. Wochenschr.*, May 21, 1908.

As the indigo carmin is not dissolved it may not be injected subcutaneously because of the resulting pain.

In twenty to forty minutes the indigo carmin begins to appear in the urine, tingeing it a greenish blue.

The test was introduced by Voelcker and Joseph,[1] not as a substitute for the phloridzin test, but rather to do away with the necessity of catheterizing the ureters. For the indigo carmin so discolors the urine (in most cases) that it aids materially in the study of the ureteral jet. Chromocystoscopy is a sort of glorified ureteric meatoscopy. Our condemnation of the latter (p. 462) may be applied to the former. In just one matter chromocystoscopy may be useful. It aids us to study more accurately the function of a ureter we cannot catheterize and to find the ureter mouth more readily. It has been employed as a test of renal function by ureter catheterism, but in this rôle it is not so useful as phloridzin.[2]

Estimation of Urea

To our mind the estimation of urea is by far the most important test of renal function. But this estimation must be made intelligently. No physician attaches much importance to the urea content of an isolated specimen of urine.

If in a given space of time one kidney excretes twice as much fluid (e. g., 2 c.c.) as its fellow does (1 c.c.), the former is doing as much vital work as the latter if it excretes a urine whose urea content is only half as great (e. g., 1 per cent as against 2 per cent). Yet, in spite of this obvious proposition, most of the estimations of renal function are based on urea percentage alone. Albarran and Barringer have especially insisted upon the importance of always estimating the urea output in centigrams. This is the best way to compare the actual work of the two kidneys.

Let us suppose, for example, that we obtain in the same space of time from the right kidney 10 c.c. of urine containing 1.3 per cent of urea, and from the left 4 c.c. containing 2.3 per cent of urea. At first sight we should say that the left kidney, in excreting urine with so high a percentage of urea, is doing better work than its fellow. Yet such is not the case. The right kidney is doing more work by putting out more urea than its fellow. We may express this in the following formula, using the letter U for urea, V for volume, and U V for urea $\times$ volume, and expressed as centigrams of urea.

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[1] *Münchener med. Wochenschr.*, 1903, L, 2028.

[2] Favorable reports of the test have been made by Voelcker *Diagnose d. chir. Nieren Erkrankungen*, 1906. Suter, *Correspondenzbl. f. Schweitzer Aerzte*, 1907, XXXVII, No. 15.

In the example taken—

$$R\,U\,V = 1.3 \times 10 = 13 \text{ centigrams of urea.}$$
$$L\,U\,V = 2.3 \times 4 = 9.2 \text{ centigrams of urea.}$$

Thus the right kidney work, as compared with the left kidney work, is not represented by $\frac{R\,U}{L\,U} = \frac{13}{23} = 0.565$, but by $\frac{R\,U\,V}{L\,U\,V} = \frac{130}{92} = 1.413$. The right kidney, instead of doing only about half as much work as its fellow, as the percentage estimation would indicate, is doing almost half as much again.

This example shows the importance of working out the equation $\frac{R\,U\,V}{L\,U\,V}$. Until this is done we have no accurate measure of the comparative work done by the two kidneys.

Moreover, these remarks apply to every test of the quality of renal function. In densimetry the important point is not R Sp. Gr., as compared with L. Sp. Gr., but $\frac{R\,Sp.\,Gr.\,V}{L\,Sp.\,Gr.\,V}$; in cryoscopy it is not R $\triangle$ and L $\triangle$, but $\frac{R\,\triangle\,V}{L\,\triangle\,V}$; in the phloridzin test it should be $\frac{R\,S\,V}{L\,S\,V}$, were not the difficulties in obtaining this equation so great.

Thus in the excretion of a given substance, X, *the relative amount of work done by the kidneys is measured by the fraction* $\frac{R\,X\,V}{L\,X\,V}$.

If this is more than 1 the right kidney is doing the more work, if less than 1 the left is superior.

But by this equation we only measure the relative renal activity during a given time and for a given substance or group of substances. In order to infer the relative physiologic activity of the two kidneys from their relative activity in excreting a given substance for a given space of time certain conditions must be fulfilled.

1. The patient must be free from all causes of renal excitation (p. 72).

2. The examination must continue for a sufficient length of time (p. 73).

3. The substance tested for must be a good index of renal function.

The urea test best fulfills this last indication. Cryoscopy and densimetry come second.

Under these conditions $\frac{R\,X\,V}{L\,X\,V}$ *usually indicates the true relative functional capacity of the two kidneys.*

Usually, but not always. The more diseased kidney may be the seat of some pathologic stimulus that excites not only polyuria but also an actual increase in its output of solids. That this can only occur in a

kidney of which some part of the parenchyma is the seat of compensatory hypertrophy has already been shown. But such compensatory hypertrophy may exist in a kidney the seat of such important lesions as hydronephrosis, pyelonephritis, calculus, or tuberculosis.[1]

In order to distinguish the true relative capacity in such cases, and in order to be as accurate as possible in any case when the difference in urea output of the two kidneys is not great, we must have recourse to other methods of examination, notably to "experimental polyuria."

Experimental Polyuria

Since the test of experimental polyuria has been developed almost exclusively by Albarran from the physiologic and pathologic data enumerated at the beginning of this chapter, we may best describe it in his own words, as follows:

The diseased kidney is much more constant in its activity than the healthy kidney, and the more completely its parenchyma is destroyed the less does its function vary.

Hence the comparison of the secretion of the two kidneys, even for the whole twenty-four hours, does not establish the exact functional relation of the two organs. On certain days, and at certain hours of the day, the disparity between the two kidneys is much more marked than on other days or at other hours.

It is even possible that the kidney which seems superior at one examination may seem inferior at a subsequent examination.

Hence the comparative examination of the urine secreted by the two kidneys during a given time can only give us very vague notions of their respective functional capacity. This remark applies to every test: to chemical analysis, to cryoscopy and to artificial elimination tests.

It is obvious also that the briefer the examination the greater the chance of error.

If instead of comparing the total quantity of urine excreted during a certain time, we compare the urine in a series of fractions of this time, we shall be studying the actual functional activity (*marche functionelle*) of the two kidneys. If, for example, instead of collecting the urines for three hours, and comparing the total excretion of the two kidneys during that period, we divide these three hours into six half-hour periods, and thus compare six specimens from each kidney, we can plot out a curve for the diseased kidney and another curve for the healthy kidney. By comparing

[1] Thus Albarran in 104 cases found the U V equation accurate 75 times, inaccurate 28 times (14 times U V equal, 7 times U V greater on the diseased side, and 7 times variable, at one examination accurate, at another inaccurate). Of these 28 cases one had nephroptosis, 10 pyelonephritis, 10 renal tuberculosis and 7 renal retention from various causes.

the progress of elimination from each kidney, as shown in these curves, we acquire some very important data since we know that the curve of excretion in a kidney is lessened in proportion to the disease of that kidney.

From numerous clinical observations Albarran concludes that the functional capacity of the two kidneys may best be tested by comparing the urines obtained while the patient is "empty and dry," then giving him water to drink and watching the effect of this upon the relative activity of the two kidneys. "This is experimental polyuria."

To perform this test Albarran employs a single ureter catheter, size 6 or 7, tests its tightness in the ureter by injection of a colored fluid, and draws the urine from the opposite kidney by a small catheter in the bladder. Having thrown away the urine passed in the first ten minutes, he collects the urine that flows thereafter, as follows:

1. Urine passed during the first half hour.

At the end of this half hour he administers three glasses of Evian water. (We employ ordinary drinking water.)

2. Urine passed during the second half hour.
3. Urine passed during the third half hour.
4. Urine passed during the fourth half hour.

He thus acquires eight specimens of urine, each representing the excretion from a single kidney for a half hour.

The functional stimulation due to the water drunk begins in the second half hour, reaches its height in the third half hour, and usually begins to subside in the fourth half hour.

When but one kidney is diseased, the result of this examination is as follows:

Quantity.—The curve of the healthy kidney rises rapidly in the second and third periods, to fall again in the fourth. That of the diseased kidney rises relatively little (or not at all). Hence if the diseased organ has been secreting more urine than its fellow, the difference is diminished or even overcome by the greater activity of the healthy kidney, while if the healthy organ is already secreting a greater quantity of urine the disparity increases.

Quality.—Urea volume and $\triangle$ V usually rise not so sharply as the quantity, and more markedly on the healthy side, while urea percentage and $\triangle$ usually fall (i. e., $\triangle$ approaches 0° F.).

Albarran concludes as follows:

A healthy kidney should respond to the polyuria excitation induced by drinking. The curve of the quantity of urine should rise, while that of the $\triangle$, urea and chlorids fall. These oscillations should be marked and cover several divisions of our charts, when the patient has drunk two or, preferably, three glasses of water. The curves of true elimination, $\triangle$ V, urea in centigrams and chlorids in centigrams may show but slight changes,

rise or fall during polyuria, making it impossible to draw conclusions without comparing the action of the other kidney.

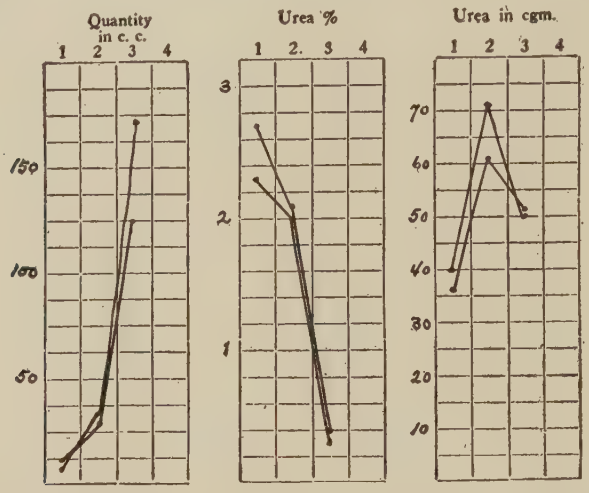

Fig. 39.—Efficient Experimental Polyuria. Both Kidneys Normal. Both ureters catheterized: no extra-catheter flow. Periods thirty minutes. No pus, bacteria, or casts from either side. Radiography negative. At end of first period patient drank two glasses of water and 15 c.c. of whisky.

When both kidneys are diseased the curves may be extremely irregular and the U V and the △ V may fall instead of rising. But *the*

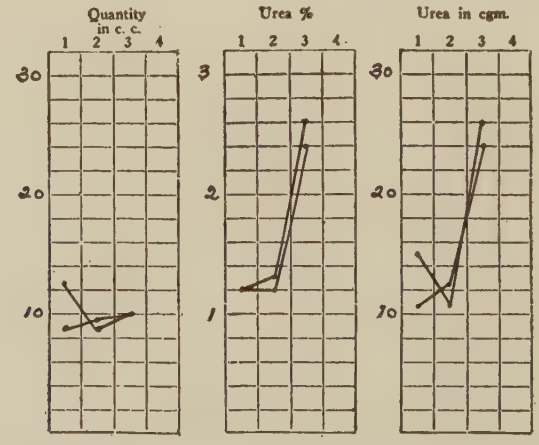

Fig. 40.—Inefficient Experimental Polyuria. Both Kidneys Normal. Catheter in left ureter; no extra-catheter flow. Periods thirty minutes. At end of first period patient drank four glasses of water. No pus, bacteria, or casts from either side. Radiograph showed shadows in pelvis which styletted catheter proved extra-ureteral. After phloridzin injection no sugar was excreted for one and a half hours.

healthier kidney always shows more marked variations than its fellow and does more work as measured by U V and △ V.

In our experience,[1] the curves of experimental polyuria do not work out as accurately as Albarran maintains.

The administration of three glasses of water at the beginning of the second half hour may not be sufficient to excite any polyuria at all, and it is often difficult to persuade the patient to drink more than three glasses. A drink of whisky or gin is often of material assistance. But, even if the polyuria is slight or absent, the test is useful, for the com-

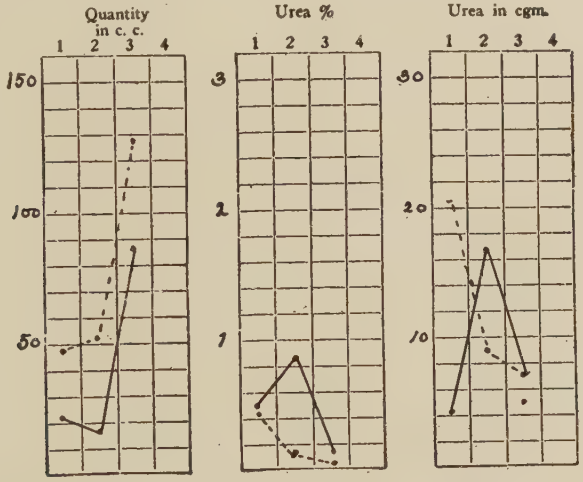

Fig. 41.—Experimental Polyuria: Aseptic Calculi in Left Renal Pelvis. Catheters in both ureters; no extra-catheter flow. Periods thirty minutes. At end of first period patient drank three glasses of water. No pus, bacteria, or casts from either side. Radiography with styleted catheter showed two stones in left renal pelvis. (These were subsequently removed by pyelotomy.) The left kidney (dotted line) was congested rather than inflamed. It responded to polyuria more brilliantly than its fellow, but with a smaller urea variation and a disturbed curve. Note misleading features of first period.

parison of the urines obtained in separate half hours verifies the findings and prevents grave error from arising through some unsuspected oversight in a single observation. Moreover, the healthier kidney, of its own accord, varies more markedly than its less healthy fellow. It is a great addition to our diagnostic measures, if for no other reason than this.

The accompanying charts (Figs. 39, 40, 41, 42, 43) illustrate personal experiences with experimental polyuria.

Summary

None of these methods of determining the renal function are adequate. Everyone who employs them depends chiefly on a certain test

[1] Trans. Am. Assn. G. U. Surg., 1909, iv.

and to a less degree on others. Perhaps the best way to summarize the present status of the subject is to recite the conclusions of various authors.

Israel in 1903 denied the value of cryoscopy and phloridzin, asserting that they were contradictory, variable, and inconclusive.[1] He cited three cases of successful nephrectomy in spite of negative phloridzin.

Rovsing [2] depends upon ureter catheterism, aided by the microscope and urea percentage. He condemns cryoscopy and phloridzin. In doubtful cases he exposes the "other" kidney by lumbar incision.

Casper and Richter [3] offer the following conclusions: Cryoscopy of the blood is "the only theoretically well-founded" method of functional diagnosis. Of the urinary tests the estimation of the onset and the simultaneous quantitative excretion of phloridzin is best, cryoscopy next, and the estimation of urea or total nitrogen per cent the least important. They employ no volumetric tests. They require catheterism of only one ureter.

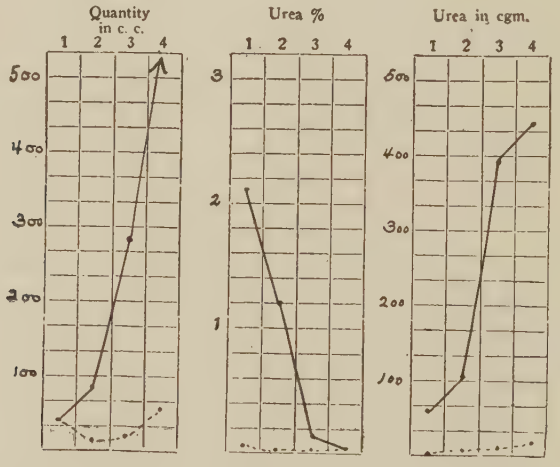

FIG. 42.—EXPERIMENTAL POLYURIA: NEPHRECTOMY (by Dr. Watson) HAD LEFT ONLY A FRAGMENT OF LEFT KIDNEY. Left kidney (dotted line) fistulous. Periods of one hour. At end of second period patient drank seven glasses of water. Fourth period estimated. Pus and bacteria from both sides. After phloridzin injection sugar was excreted by right side in fourteen minutes, by left side in seventeen minutes. Note misleading quantities in first period, spontaneous variation in second period, flat curve of diseased kidney and misleading phloridzin test (cf. Fig. 40).

Albarran [4] performs his test with the patient "empty and dry," preferably in the early morning, having previously submitted the twenty-

[1] *Mitteil. a. d. Grenzgeb. d. Med. u. Chr.*, 1903, ii, No. 2. Casper's defense of his theory appears in the same number.

[2] *Hospitalstidende*, 1904, xlvii and 1905, xliii, No. 12.

[3] "Functional Diagnosis of Kidney Disease," 1903, translated by Bryan and Sanford.

[4] *Exploration des Fonctions renales*, 1905, p. 219.

four-hour total urine to chemical analysis for several successive days. He insists upon the size and shape (p. 58) of the catheter and requires catheterization of only one ureter. He discards urine passed during the first few minutes, and studies chiefly the volume, the urea, the freezing

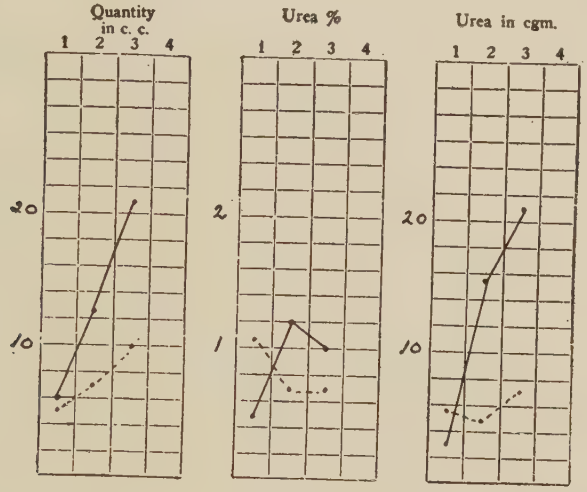

FIG. 43.—EXPERIMENTAL POLYURIA: BILATERAL PYELITIS, SLIGHT RETENTION ON LEFT SIDE (Pl. VI). Catheters in both ureters; no extra-catheter flow. Periods of twenty minutes. At end of first period patient drank three glasses of water. Pus and bacteria from both sides. Radiograph (Plate VI). Note misleading features of first period and relative flatness of curve of left kidney (dotted line).

point, and the excretion of phloridzin or of methylene blue. He always employs experimental polyuria, and insists upon volumetric estimation.

Kapsammer [1] denies the possibility of exact diagnosis unless both ureters are catheterized. He measures the amount of fluid injected into the bladder, leaves the cystoscope in the bladder throughout the examination, and measures the bladder fluid afterwards in order to estimate the leakage alongside of the ureter catheter. He denies the possibility of accurate volumetric estimation (because of leakage and reflex polyuria). He depends almost solely upon the onset of phloridzin glycosuria. After discarding the first few drops he collects the urine for ten minutes for the routine analysis, and thereafter tests the urine every five minutes for sugar. As soon as sugar is obtained from both kidneys the examination is closed. If sugar does not appear in forty-five minutes, the kidney may be considered useless. In difficult cases, if pus is seen coming from one side only and that ureter mouth is markedly diseased, the phloridzin test of the total urine may be regarded as a test of the more healthy kidney, and if the phloridzin appears within thirty minutes this "other" kidney may be considered competent to support life, unless there be severe

[1] *Niesendiagnostik*, 1907, i, 329; also *Wien. klin. Wochenschr.*, 1908, xxi, No. 40.

parenchymatous nephritis with many casts; for such he employs the indigo-carmin test and experimental polyuria.

T. Walker [1] employs the artificial elimination test, among which he prefers methylene blue, regarding it as more constant than phloridzin.

The views of Kummell concerning cryoscopy of the blood have already been described.

Here a fine array of diverse opinions on what is perhaps the most important question in urology to-day. We may sum up the probable meaning of this Babel as follows:

I. In every case the technical study of the renal function must be preceded by the routine examination of the patient's person and history and by one or more urinalyses of "twenty-four-hour" specimens.

II. In certain instances this preliminary examination tells us all we need to know in order to institute proper treatment. It may, for instance, prove that there is no renal lesion, or that the condition does not require operative treatment, or that there is closed pyonephrosis with adequate urinary excretion from the opposite side.

III. But in order to make this diagnosis more certain and in order to make any diagnosis at all in other instances, some special test of urinary function is required.

IV. Urinalysis of specimens obtained during fifteen to thirty minutes by ureter catheter or segregation establishes a positive diagnosis in almost every instance. In doubtful cases the comparison of R U V with L U V is particularly enlightening.

V. Every special test of renal function (e. g., cryoscopy, phloridzin, experimental polyuria) gives results in general conformity to the tests mentioned under I and IV. But none of these special tests are infallible; when they differ with the inferences drawn from the general examination and urinalysis it is safer to trust the latter.

VI. These special tests are most accurate when applied to the study of the relative function of the two kidneys, least accurate when applied to the study of their absolute function.

Having laid down these propositions, it is safe to venture on a discussion of the "normal" urine as revealed by functional tests.

The Normal Urine.—The urine collected from a normal kidney by ureter catheter for one hour should show the following characteristics, approximately:

Quantity—20 to 30 c.c.
Urea percentage—1.2 or higher.
Total urea—0.50 gm. or more.
Phloridzin begins in fifteen to thirty minutes.

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[1] "Estimation of the Renal Function in Urinary Surgery," London, 1907, also *Lancet*, March 2d, 9th, 16th, 1907.

Moreover, these kidney findings must be corroborated by absence of pus, albumin, casts, and other abnormal ingredients, as well as by a normal ureteral orifice and regular ureteral contractions.

Albarran says:

Study of the total elimination does not encourage categorical statements. Urea elimination from a single kidney of from 1.20 to 1.30 gm. during two hours is adequate for an adult male. We consider 0.75 to 1.0 gm. of urea in two hours mediocre and less than this bad. But a feeble woman may excrete normally but 0.9 to 1.0 gm., and we have even seen two thin, tubercular, badly nourished women whose healthy kidneys excreted only 0.52 to 0.86 gm. in two hours; but both had good experimental polyuria curves and submitted successfully to nephrectomy.

△ V shows as wide variations as U V; 12,000 to 17,000 is normal for an adult male, 8,000 to 10,000 is mediocre, 6,000 bad.[1]

In practice the normal kidney is often the kidney whose function is temporarily impaired by disease of its fellow. Such a kidney may excrete urine that fails to come up to any of the above specifications, except as to absence of abnormal ingredients. Yet if the ureter contracts normally and its orifice looks normal, it is quite within the possibilities that after nephrectomy the remaining kidney will react normally to every test. *The entire functional integrity of one kidney is often not demonstrable by the tests of renal function until after removal of disease in its fellow.*

The Other Kidney in Contemplated Nephrectomy.—It is very properly considered a disgrace to lose a patient by insufficiency of the remaining kidney after a nephrectomy, and it is chiefly in order to avoid this disgrace that the various systems of functional diagnosis have been elaborated. But, as we have seen, they have proven in the main neither delicate nor accurate enough to serve this purpose fully. They usually show which kidney is the more diseased, but they do not show accurately the functional capacity of its healthier fellow.

The difficulty with all these tests is that they have not been tried by a sufficient number of positive results; i. e., deaths by renal insufficiency after nephrectomy. Moreover, it is obvious that the danger to the remaining kidney from nephrectomy by one surgeon is not comparable to the danger from the same operation done by another surgeon.

The Diagnosis of Slight Renal Insufficiency.—The diagnosis of slight degrees of renal insufficiency has been intimately studied only by Albarran. His test of artificial polyuria is the only one that aims to distinguish slight variations in renal sufficiency. Whether it will live up to his claims the future must decide.

[1] These figures are obtained by multiplying the quantity in c.c. by the △ in hundredths of a degree.

CHAPTER VII

GONORRHEA: ITS SOCIAL ASPECTS AND PREVENTION

Gonorrhea is an acute infectious disease caused by the gonococcus. Its usual manifestation is a local inflammation of the infected surface. This inflammation is characterized primarily by redness, swelling, and exudation of pus. It extends by direct continuity and rarely by entrance of the gonococcus into the circulation. Thus gonorrhea is usually a local inflammation, rarely a general infection.

The usual portal of infection in the male is the urethra, in the female the vulva or the urethra. The disease is usually transmitted by sexual intercourse. Indirect transmission by means of clothing, etc., infected with gonorrheal pus is extremely rare, both because of the relative immunity to gonorrhea of the skin and the mouth, the only surfaces with which such articles are likely to come in contact, and also because the coccus perishes as soon as the secretion containing it dries.

Infants and young children are infinitely more susceptible than adults to gonorrhea. Indirect transmission of the disease is a frequent cause of gonorrheal vulvo-vaginitis in little girls. I have never even heard of an instance of indirect transmission in the adult male.

The only other part of the body likely to be infected with gonorrhea is the ocular conjunctiva. The well-known frequency of gonorrheal conjunctivitis neonatorum is evidence of this susceptibility in infants, but the relative infrequency of gonorrheal conjunctivitis in later life is best explained by the theory that the conjunctiva of the adult has lost its excessive sensitiveness to the gonococcus. How else explain the fact that among the innumerable filthy gonorrheics who throng our venereal clinics conjunctivitis is almost an unknown complication? It is not conceivable that their immunity is due either to the cleanliness of their hands or to the fact that these dirty hands keep away from their eyes. That an adult eye is occasionally inoculated only increases our wonder that more are not.

Genitals and eyes apart, the human integument is almost immune to gonorrhea. The rectum may be inoculated by sodomy or, in the female, by drippings from the inflamed vulva. A very few instances attest the fact that the skin and the buccal and nasal mucous membranes may be inoculated.

The importance of gonorrhea to the community rests chiefly upon three factors: first, its transmissibility by sexual intercourse; second, its rebelliousness to treatment, its capacity to extend to the uttermost parts of the urinary and genital mucous membranes and its involvement, no less terrible for being rare, of the whole economy in gonococcus septicemia; third, its chronicity and latency, which deceive the patient and even his physician into the belief that the disease is cured until a new outbreak in the patient himself, or infection of a sexual partner, or, if the patient be a parturient woman, of the eyes of her child, reveals the inveteracy and virulence of the disease.

PREVALENCE OF GONORRHEA

Prevalence in the Army.—The prevalence of gonorrhea in the army of the United States is a rough measure of its prevalence in cities among young adult males. Age, temptation, and protection are approximately the same in each case.

The figures given in the Surgeon General's Report for 1908 are the following:

Mean enlisted strength of the army—53,803 men.

Number of cases of gonorrhea treated during the year 1907—5,782 (of whom 1,942 were in the Philippines).

Days sick—134,795.

Discharged as unfit for duty—58.

Died—1.

This means that during the year 1907 more than 12 per cent of the army had gonorrhea (in the United States 10.768 per cent, in the Philippines 18.719 per cent). The average duration of the disease was about twenty-three days.[1]

One per cent of the men diseased were discharged as unfit for duty.

Let us compare gonorrhea with other diseases. In prevalence it stands easily first, with malaria (6.319 per cent) second, enteritis and diarrhea (4.926 per cent), bronchitis (4.743 per cent), and influenza (4.046 per cent) following. In noneffectiveness (number of days sick) gonorrhea is again first (36.93 per cent), followed by the other venereal diseases, syphilis (15.367 per cent), and chancroid (14.567 per cent), and with tuberculosis (14.271 per cent) fourth. As a cause for discharge from the army, however,[2] gonorrhea (58) stands fourth to tuberculosis (177), syphilis (94), and insanity (79). As cause of death it

[1] Many a case of chronic urethritis is not called to the attention of the medical officer. From infection to positive cure in civil life, the average duration is about fifty days.

[2] The detail given is "chronic gonorrhea," 21; epididymitis, 3; ophthalmia, 8; rheumatism, 20; stricture, 2; other results, 3.

is insignificant; only 5 deaths due to gonorrhea are recorded in the Surgeon General's Reports for the last decade.

From these figures it is evident that the immediate results a young man may expect from a well-treated gonorrhea are an acute sickness lasting a month or so, with about one chance in a hundred of grave or permanent impairment of function, and practically no prospect of death.

But these figures do not show the chronic gonorrhea, the sterility, the prolonged infectiousness that are the really important elements in the prognosis of chronic gonorrhea in the male.

Prevalence in Civil Life.—The prevalence of prostitution and sexual promiscuity in our cities makes gonorrhea endemic among their population; smaller towns suffer in proportion to the laxity of their morals and their proximity to urban centers, while the countryside is subjected to epidemics of the disease by the return of the Prodigal Son.

In 1901 the "Committee of Seven" [1] reported that there were apparently 162,372 patients suffering from venereal disease in New York City, and of these nearly 90 per cent were gonorrheics. There were 15,969 cases of gonorrhea actually reported, of which 1,941 were in women and 488 in children. Of these children 265 had purulent ophthalmia, 218 vulva-vaginitis, 5 urethritis.

Morrow estimates [2] that 60 per cent, Forscheimer [3] that 51 per cent of the adult male population of the United States have gonorrhea. He adds: "Twenty per cent of these young men will become infected before their twenty-first year, over 60 per cent before their twenty-fifth year, and more than 80 per cent before they pass their thirtieth year."

Among women gonorrhea, though more severe, is less common than among men. In the statistics given above the proportion of men to women is 16 to 1. It is shocking to learn that almost one third of the reported cases of gonorrhea occurred in married women, to whom the infection had been conveyed by their husbands. Nine hundred and eighty-eight cases of marital infection were reported, and the unreported cases were believed to be six times as numerous.

Add to this the ghastly array of 488 children with ocular and genital gonorrhea. Truly the much-heralded *syphilis insontium* pales before *gonorrhea insontium!*

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[1] *Medical News*, December 21, 1909.

[2] "Social Diseases and Marriage." Also Trans. Am. Soc. Sanitary and Moral Prophylaxis, 1906, i, 18.

[3] *Boston Med. and Surg. Jour.*, Aug. 6, 1908. The statistics of gonorrhea in Germany and Austria are given by Erb (*Münich. med. Wochenschr.*, 1906, liii, p. 2329, and 1907, No. 31) and Blaschko (*Zeitschr. f. Bekämpfung d. Geschlectsk.*, 1907, vi, No. 1). Erb's contentions are approved in *Jour. Am. Med. Assoc.*, 1907, xlix, 44.

DURATION OF THE DISEASE

"A gonorrhea begins and God alone knows when it will end," said Ricord more than a generation since; and the aphorism is as true to-day as the day it was uttered. Where there are no glands (e. g., in the conjunctiva) gonorrhea runs an acute course and then disappears; but in the genital passages it shows a marked tendency to become chronic by causing chronic glandular catarrh and peri-glandular sclerosis.

From the male urethra the gonococci usually disappear within six months. Persistence of gonococci for more than eighteen months in the male urethra is exceptional. The catarrh may well continue longer than this, but it is kept alight by the associated microörganisms that persist after the gonococcus has disappeared.

The exceptional case whose gonococci remain alive and at least potentially virulent for two or three years—I have not known them to persist any longer—proves the possibility of an indefinite infectiousness.

Indeed, the infectiousness of gonorrhea in the male is comparable to that of typhoid fever. Most cases last an indefinite number of weeks and are cured. A small number continue infectious. It may be a matter of great delicacy to determine the persistent infectiousness of a given case. But this does not alter the fact that almost all are cured within a few months.

But gonorrhea in the female is a very different matter. Conservative gynecologists are entirely unwilling to set any limit to its infectiousness and are confessedly incompetent in some instances to cure it, in others to say whether it is cured or not. I have known a woman to infect her partner seven years after her own infection.

To be sure most women, like most men, recover from gonorrhea in a few months. But the exceptions in women are much more indefinite in duration, much more difficult of diagnosis, much more rebellious to treatment.

The vulvo-vaginitis of young children is exceedingly intractable. It commonly lasts for years.

GRAVITY OF THE COMPLICATIONS

The local inflammation, which is all that most patients see in a gonorrhea, is actually the least of its dangers.

Apart from the danger of conjunctival infection, which is common to both sexes but rare in the adult, the complications due to direct extension of the disease are different in the two sexes.

In man the complications are almost entirely under the control of the skillful physician with a faithful patient. But both are rare, and patients in the poorer classes have neither the means nor the leisure to avail themselves of the resources of medicine. Among our dispensary

patients the greater number suffer the pangs of an acute posterior urethritis, and some 10 per cent to 20 per cent suffer acute epididymitis, which in perhaps one quarter of these is bilateral and results in sterility. Chronic urethritis or prostatitis result in fully 70 per cent or 80 per cent of these cases, and severe urethral stricture in a small percentage.

Sexual neurasthenia follows gonorrhea in 5 per cent to 10 per cent of clinic cases.

Among our wealthy patients, who are well treated from the onset of their disease, epididymitis complicates less than 5 per cent, chronic urethritis and prostatitis less than 20 per cent, and stricture is altogether exceptional. But even the wealthiest patient may not be willing or able to command good treatment at the onset of his gonorrhea, so that more than half the patients treated in the office of the specialist suffer from chronic gonorrhea.

Such complications as prostatic and periurethral abscess and pyelonephritis are rare in the clinic, extremely rare in private practice.

In women, on the other hand, grave complications are common. Invasion of the uterus, the uterine adnexa, and the peritoneum were noted in 40 per cent of the women reported to the Committee of Seven.

Gonorrhea reaches the uterus in 20 per cent, the tubes in 5 per cent of cases, says Schmidt.[1]

This invasion of the female generative organs takes place either at the time of infection or after the birth of the first child. For the gonorrhea may subside and become latent in the glands of the uterine cervix until pregnancy excites a congestion that increases the virulence of the gonococci. By these the child's eyes are endangered at birth, its mother's uterus and tubes immediately thereafter.

Gonorrhea of the uterus and tubes usually, though not always,[2] implies sterility. Hence this sterility is total if the wife's tubes or uterus are promptly infected; it is the so-called one-child sterility if they are infected at the time of parturition. Neisser and Bumm agree that the gonococcus causes about 30 per cent of sterility in women, while Morrow states [3] it is responsible for fully half of involuntary sterility.

But, besides depriving a woman of her children, gonorrhea may render her a permanent invalid, may even cost her her life. It is a curious fact that gonorrhea in women is either much milder or much more severe than the disease in man. Some women are so little inconvenienced by it that they do not feel the need of summoning a physician. Others are overwhelmed by acute salpingitis, pelvic abscess, peritonitis even; they must either undergo a capital operation or die. Still another class suffer

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[1] *Zeitschr. f. Geb. u. Gyn.*, vol. xxi.

[2] Moskowitz has reported a tubal pregnancy coexisting with pyosalpinx.

[3] *Am. Journ. of Surgery*, 1906, xx, 236.

relatively less from the tubal or uterine complications at first; they are not mortally ill, but they are up one day and down the next, semi-invalids all the time, with scarce a hope of release, unless it be by oöphorectomy, a capital operation, implying loss of the faint remaining hope of children and perhaps a continued invalidism thereafter.

Compared with these major evils the danger of infection of the eyes by the fingers or to the rectum by drips of vaginal secretion is nothing.

Children are doubly endangered by gonorrhea. In the first place, their eyes are in imminent danger of inoculation at the moment of parturition. From such inoculation is said to result more than one third of congenital blindness.

In the second place, the infant or the young child remains peculiarly susceptible to gonorrheal infection. Its eyes or its genitals may be the portal. Gonorrheal conjunctivitis and urethritis (in the male) present no very peculiar characteristics in the infant. But gonorrheal vulvovaginitis in little girls has a horror all its own. The quite inexplicable readiness of infection, the rebelliousness to treatment, the grave and life-long complications make it seem one of the cruelest of known maladies.

The last count in the indictment of gonorrhea is systemic gonorrhea, often spoken of as gonorrheal septicemia or gonorrheal rheumatism. Systemic gonorrhea is very grave, quite rare, and fairly controllable. It is grave in that it causes iritis, endocarditis, a very chronic type of chronic rheumatism, and many other lesions. It is, fortunately, rare; its frequency being estimated at about 1 per cent of cases (Kolle and Hetsch say 0.7 per cent; Ward says 1.2 per cent). Of its control there is no absolute certainty. The disease in most instances progresses slowly to spontaneous cure. Our modern sera and toxins are a great help in treatment. Taking all in all, the horrors of gonorrheal rheumatism are more talked about than they deserve. Only 20 of the 5,782 gonorrheics in the army were permanently incapacitated by it.

SOCIAL IMPORTANCE OF GONORRHEA

The social importance of gonorrhea depends upon its prevalence, its transmissibility, its grave results in women and children, and the sterility in which it so often results.

Prevalence.—A disease that attacks more than half our young men, a disease that affects thousands of children and hundreds of thousands of women, is important to society by its prevalence alone.

Transmissibility.—A disease that enters the family almost exclusively through illicit sexual contact, a disease that may be transmitted long after the patient thinks himself or herself well, a disease that may be transmitted to the wife from the prostitute via the offending husband, a disease that may be passed from the wife thus innocently infected to

the eyes of her infant at birth or to its genitals thereafter, is eminently important to society.

Grave Results.—A disease that incommodes the man and may invalid the woman, a disease that is the cause for most of the major gynecology of to-day, a disease that unsexes thousands of women, that makes chronic invalids of many, that kills not a few, a disease that in this country causes from one quarter to one half of the congenital blindness, that is accountable for about one third of the blind in our asylums, is a real peril to society.

Sterility.—A disease that causes fully 50 per cent of the involuntarily sterile, or one-child sterile marriages, that destroys the power of procreation in man as well as in woman, is indeed a peril to the race.

SOCIAL REMEDIES

Three types of remedy for gonorrhea are submitted to society:

Individual prevention.

Methods of dealing with prostitutes.

The moral campaign.

To discuss fully the relative merits of the three would require a volume.[1] Suffice it to say here that an individual prevention, injection of the urethra after a suspicious intercourse (p. 217), though diminishing greatly the danger of infection, does not entirely eliminate it. Segregation and reglementation of prostitutes is successful in proportion to the intelligence with which it is conducted, while the moral campaign, the attempt to bring venereal disease and all sexual matters out into the light of day, seems the only way to get at the root of the evil.

Reglementation is employed with notable failure in France, with mediocre success in Germany. In our country it is impracticable.[2] It fails in theory by not quarantining the males, in practice by not quarantining "illicit" females, the lewd housemaid or shop girl, and the errant widow.

The moral campaign of education to old and young still has its spurs to win. It is very full of promise. The notion that child and bride need education in matters sexual, and that the boy needs clean ideas on these subjects is a new one. But it is hard to see how such education can fail to save many innocents from venereal disease and from moral woes far worse.

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[1] The important publications on these subjects are discussed in the various societies of Sanitary and Moral Prophylaxis and of Social Hygiene. Reference may be made to: *Trans. Am. Soc. Sanitary and Moral Prophylaxis, Bull. soc. franç. de prophylaxis sanitaire et morale, mitteilungend. Deutsch. Gesellschaft z. Bekampf d. Geschlechtskrankh.* Also to the publications of the Chicago Soc. of Social Hygiene and the N. Y. Ass'n for the Blind.

[2] "The Social Evil," Putnam and Co.

CHAPTER VIII

THE GONOCOCCUS

That the gonococcus is the cause of gonorrhea is no longer a subject for discussion. Ricord's "*recette pour attraper la chaude-pisse*" is answered by the aphorism of Marcel Seé: "La plus belle femme du monde ne peut donner que ce qu'elle a." No person can impart or acquire gonorrhea except by imparting or acquiring the gonococcus.

The gonococcus is a nonmobile diplococcus, occurring within as well as without pus and epithelial cells. It stains readily with the familiar anilin dyes. It does not take the Gram. It will not grow on the usual culture media. It produces endogenous toxins. It cannot be inoculated upon animals.

Microscopic Characteristics.—When a drop of gonorrheal pus is properly stained and examined through an immersion lens of $\frac{1}{12}$ aperture, the gonococci seen present the following characteristics:

1. It is a diplococcus. Each individual of a pair is D-shaped (coffee-bean shaped), with the flat (or slightly concave) border opposed to its fellow, so that the couple form an ovoid made up of two separate hemispheres. The length of the pair averages about 1.6 μ, and the interspace is about half as wide as either segment.

2. The diplococci are found grouped in pairs, fours, and other multiples of two, showing a tendency to rectangular disposition, in marked contrast to the irregular massing of staphylococci and the linear arrangement of streptococci.

3. The gonococcus, when it occurs in pus, is found both within and without the pus and the epithelial cells.[1] Indeed, the most characteristic groups are met with inside the cells. The extracellular gonococci may be scattered or irregularly grouped, but the intracellular specimens present a greater regularity of arrangement. Without being mathematically distributed, there is still a certain symmetry in the grouping, an absence of jumbling, which the observer soon learns to appreci-

[1] There is no close clinical relation between the intracellular or the extracellular position of the gonococci and the grade or the stage of the inflammation. Every specimen contains gonococci both inside and outside the cells, and in no definite proportion. At the onset and at the close of the infection the organisms are more commonly extracellular, but clinical exceptions to this general rule are numerous.

ate at a glance and which our plates attempt to reproduce (Plate II, Figs. 1, 2).

Such are the characteristics of the gonococcus. It is a double D diplococcus occurring intracellularly and in typical groups. But these characteristics are sometimes shared by other bacteria met with in urethral pus. We must look further for a distinguishing feature. This we find in the reaction of the gonococcus to the Gram stain.

Gram Reaction.—*Gonococci do not take "the Gram."* This means that if these cocci are stained first with an anilin dye and then with Lugol reagent (see below) the resultant stain may be washed from them, from the cells, from many other bacteria, but *not from staphylococci* and other Gram-positive cocci which, under the microscope, otherwise resemble true gonococci. Hence, when the Gram stain is applied, a thorough washing with alcohol leaves the cells and gonococci colorless, while the pseudogonococci stand out in bold relief, stained darkly by the combined color of the anilin dye and the Gram stain.

In order to make the effect of the Gram stain more apparent, it is customary to restain the cells and gonococci with a contrasting color, in order that the true gonococci may be visible for direct comparison with the false (Plate II).

Preparation of the Specimen.—From what has been said in the preceding paragraphs, it is clear that recognition of the gonococcus depends upon the proper preparation of the specimen—the proper performance of the Gram test—and while the test is not complicated, it is delicate, and, like so many other laboratory methods that appear entirely simple when one is familiar with them, it does not succeed at the hands of the beginner. Hence every practitioner is by no means competent to perform and interpret the Gram stain; but anyone who can smear a slide and focus a microscope may become competent by practice.

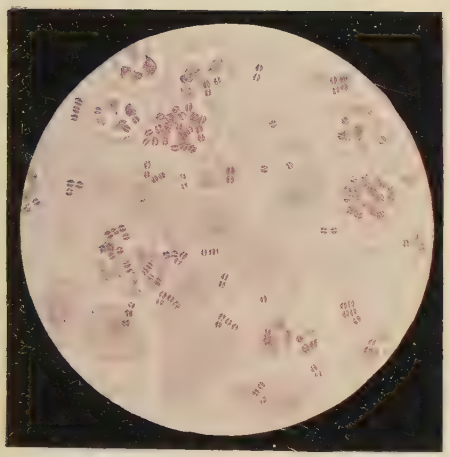
I. *The Smear.*—A very small drop of the pus to be examined is placed upon a clean glass slide. Upon this another slide is dropped, the two pressed together and slid apart. This leaves each covered with a thin film of pus (the thinner the better). Each is then dried by evaporation at a gentle heat and fixed by rapidly passing it three or four times through the flame of a spirit lamp or a Bunsen burner.

II. *The First Stain.*—One of the films is now covered with Paltauf's solution.[1]

This is left on for three minutes, the excess washed off with water

[1] Anilin oil, 3 parts; absolute alcohol, 7 parts; distilled water, 90 parts. Shake for two minutes. Filter through moistened paper until filtrate is clear. Add two grams of Grübler's powdered gentian violet. Set aside for twenty-four hours. Pipette supernatant fluid as required.

This solution has been used at Vienna for twenty years. It keeps well for six weeks, i. e., longer than any other.



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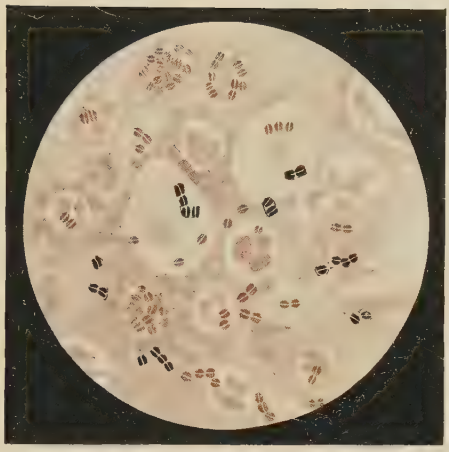

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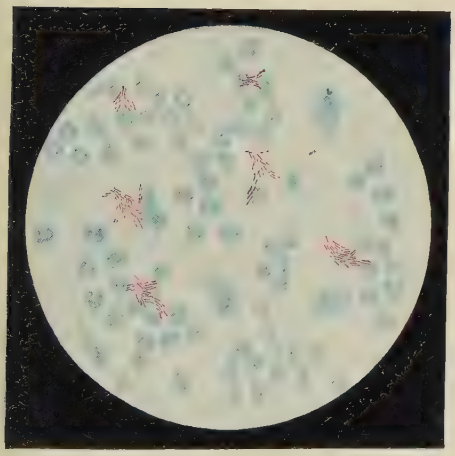

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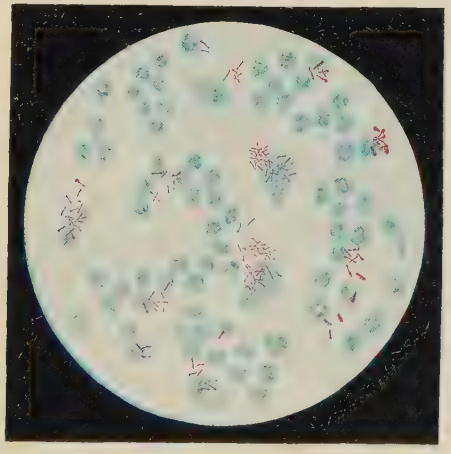

4

GONOCOCCI AND TUBERCLE BACILLI.

FIG. 1.—Gonorrheal pus. First stain: gentian-violet solution.

FIG. 2.—Gonorrheal pus. Bismarck-brown. Cells and gonococci take the brown stain, while the pseudo-gonococci remain black.

FIG. 3.—Tubercle bacilli in urine.

FIG. 4.—Smegma bacilli in urine.

(no water must be used if the Gram stain is to be employed), the glass dried in the flame, and examined with the oil-immersion lens. If no bacteria with the morphological characteristics of gonococci are seen after a careful examination, it is a waste of time to employ the Gram. But if what appear to be true gonococci are found, the Gram test is applied to the other cover-glass. The stain is applied for three minutes, as above described, but this time the excess of solution must be shaken from the specimen. *No water or alcohol* may be applied at this juncture. The slide is immediately blotted and flooded with Lugol's solution.

III. *The Lugol.*—Lugol's solution is made up as follows:

Iodin—1 part.
Potassium idodid—2 parts.
Distilled water—300 parts.

This is applied for precisely two minutes.

IV. *The Alcohol.*—As soon as the slide is removed from the Lugol solution it should be washed with absolute alcohol for precisely thirty seconds.

V. *The Contrast Stain.*—After using various more or less satisfactory counter-stains I now employ only the following:

Carbolic acid—2 parts.
Saturated aqueous solution of Bismarck brown—98 parts.

If the decolorized smear is covered with this solution for three minutes or five minutes and then rinsed in water, it acquires a light-brown tint, and under the microscope the cells and gonococci appear yellowish and in marked contrast to the deep purple, almost black, pseudogonococci. A more prolonged staining with the brown gives the gonococci a deeper color, which is not so readily distinguished from that of the pseudogonococci.

Such is the technic of staining the gonococcus, which may be employed by anyone having an elementary familiarity with medical microscopy, and which may be depended upon to furnish accurate results, if followed accurately. The essentials likely to be overlooked are the employment of *Grübler's* violet, *precise* staining, by the watch, employment of *absolute* alcohol, and exclusion of *all* water until after counter-staining.

Gonococcus Culture.—The gonococcus can be made to grow only on special media and under special conditions.

The medium must contain human blood serum and be slightly alkalin. This serum may be obtained from an aseptic effusion into the peritoneum, the pleura, or the tunica vaginalis. (Experts can obtain slight growth of gonococci upon ordinary culture media.)

Heiman [1] employs the following culture medium:

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[1] *Med. Record,* 1895, XLVII, 746; *Ibid.,* 1896, L, 887; *Ibid.,* 1898, LIII, 80.

Sterilized liquid chest serum, 1 part.

Agar, 2 per cent + peptone, 2 per cent + salt, 0.5 per cent + glucose, 2 per cent, 2 parts.

He sterilizes the liquid by heating it to 65° C. for one hour for six days, then he leaves it three days at the room temperature, then resterilizes for three days more.

The incubator must be kept at a temperature between 30° and 39° C. The ideal temperature is 36° to 37° C.

The growth of gonococci is relatively slow. They are aërobic and facultative anaërobic. The colonies remain rounded and usually do not run together. They are grayish in color and slightly translucent. Growth ceases in about forty-eight hours; sooner if the surface of the agar dries. Examination should therefore be made at the end of the second day. To continue the growth it must be shifted to a new medium every three or four days or oftener.

The vitality of the gonococcus is slight whether in smears or in culture. Desiccation kills it in a few hours. But Heiman has cultivated the gonococcus from a thick drop of pus twenty-nine days old. It is killed by a temperature of 45° C., and ceases to grow below 30° C. Any weak antisepsis rapidly destroys the gonococcus *in vitro*.

Diagnosis of the Gonococcus.—The gonococcus is distinguished from staphylococci and other Gram-positive cocci by the Gram stain. But there are other Gram negative cocci from which the gonococcus can only be distinguished by culture.[1] Such are the micrococcus catarrhalis, the diplococcus intracellularis, and certain chromogenic cocci. That these differ somewhat in shape, size, and grouping, that some are diplococci, while others are micrococci, does not constitute sufficient differentiation.

Happily none of these organisms, except the micrococcus catarrhalis, have been identified in the genito-urinary tract. None of them, except the m. catarrhalis, is believed to cause urethritis. The urethritis caused by m. catarrhalis is probably insignificant, and not to be clinically mistaken for acute gonorrhea. For clinical laboratory diagnosis of acute genital gonorrhea it is, therefore, only necessary to identify a Gram-negative, intracellular diplococcus.

The gonococcus in the conjunctiva and in joint exudates is equally unmistakable.

Chronic nongonorrheal or postgonorrheal urethritis or endometritis may, however, contain the m. catarrhalis or some other Gram-negative intracellular micrococcus. So rare is this that I have personal knowl-

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[1] *Cf.* Zupink, *Berl. klin. Wochenschr.*, 1906, No. 52; Wollstein, *Jour. of Exper. Med.* 1907, September 21st, Elser.

edge of no case in which it has been proven. Yet for a medico-legal opinion or for the prohibition of matrimony the diagnosis by culture should be required.

Rectal, buccal, and nasal gonorrhea also require diagnosis by culture.

The cultural characteristics of the gonococcus have been described. An important feature in the diagnosis is that the gonococcus ferments glucose (and perhaps maltose, but not other sugars).

The micrococcus catarrhalis grows more readily than the gonococcus on the usual media. On serum-agar it makes two kinds of colonies, the one thick and crumbling like mortar does not resemble the gonococcus, the other quite similar to the gonococcus, except that the colony is smaller. But the distinguishing feature of the micrococcus catarrhalis is its inability to ferment glucose.

The other members of this group grow more readily on the familiar media. Thus the diplococcus intracellularis grows on nutrient or glycerin-agar and on Loeffler's blood serum-agar.[1]

Concerning serum reactions Elser and Huntoon state that

> When properly controlled, agglutination tests serve to differentiate the various groups from each other, providing the strains tested are sufficiently agglutinable. Diagnostic difficulties may arise in connection with certain gonococcus strains. These are unusually sensitive to the action of normal and of group agglutinins and may yield higher values in the presence of a meningococcus immune serum than moderately agglutinable meningococcus strains.
>
> Absorption tests served to differentiate the various groups of Gram negative cocci from each other and to establish the identity of the agglutinable and inagglutinable meningococcus strains.

Gonococcus Toxins and Vaccines.—Christmas [2] and Wassermann [3] have shown that gonococci produce only an endotoxin derived from dead and disintegrated microörganisms. Thus the toxin may be measured in units of bacteria. Accordingly, one speaks of a solution containing 20,000,000 or 1,000,000,000 dead gonococci, meaning a solution containing the toxins of that number of dead bacteria.

Preparation of the Toxin.—A pure culture of gonococcus is destroyed by heating for one hour at 60° C., and its sterility then tested by culture. Its concentration is then estimated in the following manner: A given amount (e. g., 0.2 c.c.) is mixed with an equal amount of freshly drawn normal human blood. A smear is made of the mixture. This is stained in the usual way and a comparative count of the red cells and

[1] Elser and Huntoon (*Jour. of Med. Research*, 1909, xx, 369) have studied exhaustively the cultural, fermentation and serum reactions of the Gram-negative cocci.

[2] *Am. Institut Pasteur*, 1900, XLV, 331.

[3] *Berl. klin. Wochenschr.*, 1897, No. 32.

gonococci made. Estimating 5,000,000 red cells to the c.c., one readily establishes the number of gonococci to the c.c.

The toxin is now sold by several firms in phials containing 20,000,000 to 500,000,000 dead gonococci to the c.c.

Autogenous and Stock Vaccines.—Teague and Torrey[1] have shown that the serum of an animal immunized to one strain of gonococcus does not cause fixation of complement when tested against an antigen obtained from another strain. Following up this line of investigation Torrey was able to differentiate three strains of gonococci in New York City, and most of the stock toxins now sold are from a mixture of these three strains.

It is difficult to compare the efficacy of autogenous and stock vaccines on a scientific basis. I have employed only the stock polyvalent vaccines, and they have given great satisfaction; but whether similar strains might not fail in other cities, I cannot say. Autogenous vaccines have the advantage of giving a definite product distinctly and certainly applicable to a given case, but they have the overwhelming disadvantage of requiring from two to four days' preparation. We cannot get them at the time when we most need them.

The Opsonic Index and the Physiologic Reaction.—The opsonic index has been little studied in relation to gonococci injections. Its reliability is contested.

Local pain from the injection is slight, local inflammatory reaction rare. General toxic or febrile reactions are not unusual if the vaccine treatment is begun at a high dose or pushed rapidly. But the discomfort of a reaction accompanied by a temperature of 103° F. and lasting not more than twelve hours is the most that may be expected, and this is an insignificant complication compared to the beneficial results that may accrue.

Dosage.—The vaccines have been employed at an average dose of 10,000,000 to 20,000,000, increased to a maximum of 50,000,000. Such doses are too small. One should begin at 40,000,000 or, in acute cases, 60,000,000 and increase by 20,000,000 or more at each dose (unless the symptoms are controlled, or the reaction is marked) until a dose of 100,000,000 is reached. Only in exceptional cases is it necessary to go higher than this.

The injections are given into the muscle. *They should not be repeated oftener than every other day.*

Results.[2]—Gonococcic vaccines have been employed in various classes of cases, viz.:

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[1] *Jour. of Med. Research*, December, 1907.

[2] Hartwell, *Trans. Maine Med. Assoc.;* Cole and Meakins, *Bull. Johns Hopkins University*, 1901; Irons, *Jour. of Infect. Dis.*, June–July, 1908; Ballenger, *Jour. Am. Med. Assoc.*, May 30, 1908, p. 1784; Van Riempst, *Polyclinic Med. Jour.*, 1909.

In localized gonorrhea—
- Acute urethritis (useless).
- Chronic urethritis (probably useless).
- Vulvo-vaginitis (doubtful).

In the complications of local gonorrhea—
- Epididymitis (useful).
- Other inflammations (useful).

In systemic gonorrhea—
- Acute arthritis or iritis (very useful).
- Chronic arthritis (very useful).
- Sepsis (sometimes specific).

Localized Gonorrhea.—So long as gonorrhea remains localized upon the genital and urinary mucous membranes it excites no systemic reaction, and is seemingly uninfluenced by the injection of vaccines. Individual instances of the cessation of an intractible gonorrhea under the administration of vaccines prove nothing. Chronic gonorrhea is, as a rule, quite uninfluenced by the vaccine treatment. I have not even noted an increase in the gonococci in the urethral discharge. Butler and Long report twelve cases of vulvo-vaginitis treated by vaccine injection every fifth day (5,000,000 to 25,000,000) with gratifying results.

Genital Complications.—It is my practice, whenever a gonorrheic develops fever or any symptoms suggestive of acute epididymal, prostatic, or periurethral complications, to administer 50,000,000 gonococci and to follow this two days later by the same dose if all is well, by double the dose if the symptoms continue.

One is thus able to abort the threatened complications in many cases. I have succeeded in aborting epididymitis in about 30 per cent of cases.

When the metastatic (e. g., epididymal) focus is established, however, I have seen no positive good result from vaccine.

Systemic Gonorrhea.—The vaccine treatment finds its most rational application and achieves its best results in the treatment of systemic gonorrhea.

Injection of 50,000,000 dead gonococci, followed every second day by injection of 100,000,000, should, after six or eight injections, markedly improve more than 75 per cent acute joint lesions. In most cases relief is marked after every injection and is realized within six or eight hours.

In the treatment of iritis the vaccine has not shown itself so brilliantly successful.

The treatment of chronic arthritis by vaccines is complicated in two ways. In the first place, the inflammation may be unaffected by the ordinary doses. Thus my associate, Dr. Chetwood, had a case that reacted to nothing less than 300,000,000, and did not show any marked benefit from the treatment until a dose of 500,000,000 was reached.

In the second place, the painful lesion of many so-called cases of chronic gonorrheal arthritis is an organic one, an exostosis or a change in ligament or synovial membrane due to a gonococcal inflammation that has passed, and preëminently unsuited to any vaccine treatment.

With these reservations, the vaccine treatment of chronic gonorrheal arthritis is likely to give very satisfactory results.

Gonorrheal septicemia sometimes reacts brilliantly, sometimes not at all. Autogenous vaccines should be used if possible.

Antigonococcus Serum.—The antigonococcus serum employed in this country is that of Rogers and Torrey.[1] The serum is polyvalent (like the vaccine). It is derived from rams, since their serum seems much less toxic than that of goats or rabbits.

Technic.—Two c.c. of the serum are injected every day or every second or third day. The serum should be placed deep, but not necessarily into a muscle.

Complications.—With ram serum the only reaction that one may anticipate is a varying amount of local swelling, redness, heat and soreness around the point of injection. This does not occur by any means in every individual case, and is not caused by any anti-body in the serum, but is due to the local toxic action of the serum itself. As the same serum has been found to cause this reaction in one individual but not in another, it is partly referable to the idiosyncrasy of the patient. (Rogers.)

Results.[2]—The results reported from the use of the serum are quite similar to those reported from the vaccine. I have not experimented with the serum.

Rogers claims good results in 85 per cent of early joint cases, and some good in late cases if treatment is continued for a month or more. Herbst, using three times the usual dose, achieved very satisfactory results in all chronic joint cases, but nothing in epididymitis and acute arthritis. Swinburne warmly advocates the serum at the onset of epididymitis, stating that in 27 cases so treated the pain was relieved in forty-eight hours.

Immunity.—The gonococcus confers a relative immunity to the person who harbors it. He can usually not be reinfected; e. g., by a woman upon whom he has conferred the disease. Moreover, relapses of a given gonorrhea are almost invariably less severe than the initial outbreak.

But the immunity that persists after a cured gonorrhea is of the slightest. Subsequent attacks are usually milder than the initial one, but they may be quite as prolonged, quite as complicated.

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[1] *Jour. Am. Med. Assoc.*, January 27, 1906 and September 14, 1907.

[2] Rogers and Torrey, *loc. cit.;* Herbst, *Jour. Am. Med. Assoc.*, May 23, 1908. Swinburne, *Jour. Am. Med. Assoc.*, January 26, 1907 and *Med. Record,* November 14, 1908.

CHAPTER IX

GONORRHEA: THE EXTRAGENITAL TYPES OF INOCULATION; THE SYSTEMIC MANIFESTATIONS

The gonococcus is specific to the human race. It is impossible to give gonorrhea to any animal.

The gonococcus may be inoculated readily in the eye, in the urethra of either sex, and in the female genital passages. The rectum is less vulnerable than the genitals. The mouth and nose are all but immune. The unbroken skin cannot be inoculated, and all squamous epithelium offers a marked resistance. Thus the urinary bladder, the preputial cavity of the male and the vagina of the female suffer rarely and, as a rule, mildly from gonorrhea, except in so far as they are involved in the contiguous inflammation of the urethra, the cervix, or the vulva.

That children are much more vulnerable to gonorrhea than adults is evidenced by the readiness with which little girls acquire vulvo-vaginitis, the frequency of gonorrheal conjunctivitis in children, and the fact that nasal and buccal gonorrhea occur almost, if not quite, exclusively in children.

EXTENSION OF THE DISEASE

Gonorrhea of the eye and rectum remain localized. In the genitals the disease extends by continuity as far as the vesical trigone, and throughout the genitalia of both man and woman.

The gonococcus penetrates the epithelium of the inflamed surface and excites exudation and subsequently sclerosis in the subjacent connective tissue; but it shows no great tendency to cause lesions to any depth except when shut in by inflammatory occlusion of the orifice of a gland. Under such circumstances it may cause abscess, invade the veins (thrombosis), and be carried to distant parts of the body, there to set up metastatic gonorrheal foci.

Clinically this local suppuration and general intoxication occur almost exclusively in the genitals; i. e., the urethra, prostate, vesicle, and epididymis of the male, the glands of the urethra, vagina and cervix, and the Fallopian tubes in the female.

By means of the blood stream gonococci may be carried to almost any

organ. The favored locations for systemic gonorrhea are the joints and the iris. Less frequently it attacks the bursæ, the tendon sheaths, the pleura, the meninges, the periosteum, the parotid gland, the veins, the endocardium, the pericardium, the muscles.

Lymphatic absorption is uncommon and gonorrheal lymphangitis and lymphadenitis rare.

Absorption of gonorrheal toxins may affect the nervous system or the skin.

The peritoneum is not rarely involved in gonorrheal salpingitis, but gonorrheal peritonitis is extremely rare in the male. The kidneys are probably reached by gonococci from the blood stream, though direct invasion from an infected bladder is not impossible.

ANO-RECTAL GONORRHEA

The anus is relatively immune to the gonococcus. Every acute vulvar gonorrhea pours pus over it, and yet, even in infants, it is not often inflamed. Jullien has [1] collected from the statistics of Howard, Schultz, and Baer 1,037 cases of genital gonorrhea in women with 157 inoculations of the anus.

Etiology.—Sodomy is the accepted cause for anal gonorrhea; but the infection is more often due either to direct inoculation by pus from the vulva or by indirect inoculation from the douche tube or the finger.

Pathology.—The lesions are both deep and chronic. The epithelium of the rectum is eroded, infiltrated, and in places ulcerated for several inches up from the anus.

Fissure and condyloma are common; the anus itself is infiltrated. Ischiorectal abscess and phlebitis of the hemorroidal veins have been noted as rare complications. Whether or not rectal gonorrhea is often a cause of stricture is not determined. The stricture is usually observed so late that its cause is not clear.

Symptoms.—The symptoms are so slight that the condition is often overlooked. At the onset there is at most itching and burning. Later there are to all intents and purposes no subjective symptoms.

Physical Signs.—The lesion is rather rectal than anal. The anal orifice may be swollen; it is almost always fissured—"at six o'clock," as the French say. A single moist, pointed, soft condyloma usually overhangs the fissure. There is often no external discharge, but a drop of pus may readily be expressed by pressure from the rectum. Proctoscopy reveals tumefaction, erosion, and ulceration of the rectum.

Duration.—Rectal gonorrhea is extremely chronic. Jullien treated four successive cases 116, 169, and 174 days before achieving a cure.

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[1] *Le Blennorrhagie (formes rares et peu connues)*, Paris, 1906. Also Brunswick-le Bihan, *Bull. de l'Acad. de Med.*, Paris, 1907, LXXI, p. 497.

Diagnosis.—The gonococcus may be identified in the pus. If the condition of the genitals leaves any doubt as to the nature of the inflammation, the diagnosis should be verified by culture.

Treatment.—The rectum may be irrigated daily with potassium permanganate (1 : 200 to 1 : 25) or with protargol (2 per cent to 10 per cent). Erosions and ulcers may be touched every second or third day with a nitrate-of-silver pencil.

BUCCAL AND NASAL GONORRHEA

That gonorrheal inflammation of the mouth and nose may occur we cannot doubt. That it does occur in infants may be considered proven. But its existence in the adult is at best uncertain.

The existence of buccal gonorrhea in infants was proven by Ahlfeld.[1] Kimball [2] has reported 8 cases of systemic gonorrhea in infants, one or more of whom was doubtless infected from the mouth. De Stella [3] has apparently proven the existence of infantile nasal gonorrhea.

In adults, however, we hear only of sporadic cases. The cases collected by Jullien fall under two heads, those in which urethral gonorrhea has been attributed to coitus alone (cases of Howard and Honnorat) and those in which stomatitis (cases of Cutler, Petit, Columbrine, Juergens, and four of Menard) or rhinitis (cases of Duncan (1784), Forcade, Edwards) are alleged to be gonorrheal.

The evidence against nasal gonorrhea in the adult is summed up in the experiments of Diday and Bormiere, who strove in vain to inoculate the nasal mucosa with gonorrheal pus. The clinical cases in favor are rare, ancient, and unconvincing.

Buccal gonorrhea is fortified by more modern instances. But the alleged gonococcus found may perfectly well have been the meningococcus or micrococcus catarrhalis, and the "intense" stomatitis is precisely what one would not expect.

A typical report has recently been made by Juergens.[4] The stomatitis was intense, the gums ulcerated, the breath fetid. Bacteriologic examination revealed the "gonococcus" and the bacteria of Vincent's angina.

In this instance the stomatitis was doubtless a Vincent's angina, the "gonococcus" a micrococcus catarrhalis. Until such cases are tested by culture we cannot form a final decision.

Clinical Picture.—In infants the inflammation appears to be a severe one and always confined, curiously enough, either to nose or mouth. In

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[1] *Berl. klin. Wochenschr.*, October 19, 1896.
[2] *Med. Record*, 1903, LXIV, 761.
[3] *Deutsche Med. Zeitschr.*, 1899, No. 1.
[4] *Berl. klin. Wochenschr.*, June 13, 1904.

some instances nasal gonorrhea has accompanied ophthalmia neonatorum and has been attributed to infection through the lacrymal duct.

The duration of the inflammation is a few weeks, as a rule.

Treatment.—Antiseptic mouth wash and nasal spray effect a speedy cure. Argyrol in 20-per-cent solution is the best wash, but frightfully dirty.

SYSTEMIC GONORRHEA

The gonococcus invades the system through the blood stream. Its toxins may be absorbed by the same route. Though no one has disproven the participation of gonococcus toxins in the causation of the local lesions of systemic gonorrhea, the gonococcus has so frequently been found in the pus of joints and on the vegetations of heart valves that such lesions are attributed to the bacterium itself, leaving certain rare and manifestly toxic phenomena attributed to the toxin.

Toxic Lesions.—Skin lesions, neuroses.

Bacterial Lesions.—Arthritis, osteo-arthritis.
Endocarditis, pericarditis.
Bursitis, tenosynovitis.
Periostitis, osteitis.
Myositis, abscess.
Iritis, systemic conjunctivitis.
Phlebitis, thrombosis.
Pleurisy, pneumonia, parotitis.
Neuritis, meningitis (?).

In the male, systemic gonorrhea is said to complicate about 1 per cent of treated cases of genital gonorrhea. It is certainly less frequent in private practice, probably more frequent in the clinic. It is much rarer in women than in men. In children it is not especially uncommon.

Erythema and Neurosis.—Erythema, urticaria,[1] pruritis,[2] and various neuroses may occur during gonorrhea and may be relieved by cure of the gonorrhea. But whether this proves the gonorrhea to be the exciting cause of the lesion through absorption of gonococcus toxins or whether the gonorrhea is simply the occasion of an outbreak in a predisposed person is an open question. The great rarity of these conditions and the fact that they do not appear when the toxins are actually injected under the skin make it seem probable that they are purely accidental.

The feeling of disgust, even amounting to neurasthenia, excited by "venereal" disease is, of course, purely psychic. Sexual neurasthenia is not peculiar to gonorrhea.

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[1] Orlipski, *Münch. med. Wochenschr.*, October 7, 1902.
[2] Domenici, *Gaz. degli. osp.*, March 1, 1903.

GONORRHEAL ARTHRITIS

Gonorrheal arthritis or gonorrheal rheumatism, as it is commonly called, is the commonest type of metastatic gonorrhea.

Occurrence.—Gonorrheal rheumatism is said to occur in about 1 per cent of persons afflicted with urethral gonorrhea. Children are particularly prone to it and may develop it from slight local lesions. Thus Kimball [1] found 10 cases of gonorrheal arthritis among 70 children. Women are much less often affected than men, doubtless because they lack the prostate. Northrup [2] reports 230 cases in the male to 22 in the female. It has been noted by Fournier as early as the fifth day after the onset of gonorrhea, but is commonest between the third and the fifth week. It may occur at any time while the patient harbors gonococci.

Distribution.—The lesions are often polyarticular. Among Northrup's cases 76 per cent showed involvement of three or more joints. Moreover, synovitis, bursitis, and the other lesions of systemic gonorrhea are often associated with joint lesions.

The knee is the joint most frequently affected (two thirds of Fournier's 120 cases, one third of Finger's [3] 375, seven eighths of Boneman's 278 cases).

Northrup's statistics show gonorrhea of the knee in 91 cases, of the ankle in 57, of the foot in 40, of the wrist in 27, of the heel and toes in 21, of the elbow in 18, of the hip and shoulder in each 16, of the hand in 11.

The association of gonorrhea with spinal arthritis has been suggested by Bouchard [4] and Chute.[5]

Pathology.—Gonorrheal arthritis is but a single expression of a general infection. Like other forms of septic arthritis, it depends upon bacterial localization; that is, either in the joint itself or in the articular extremity of the bone. Hence the two distinct types of the disease, gonorrheal arthritis and gonorrheal osteo-arthritis.

Gonorrheal Arthritis.—The condition varies from the mildest cases to those with much exudation, pararticular infiltration and serious joint disability. The pathology is that of all the other septic arthritides, with the exception that in the severer cases there is more apt to be pararticular infiltration.

The process in the joint is proliferative in the milder cases, destructive in the severer ones. Following the subsidence of the acute inflammation,

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[1] *Medical Record*, 1903, LXIV, 761.

[2] *Presbyterian Hospital Report* (New York), 1896, vol. i, p. 53.

[3] *Archiv f. Derm. u. Syph.*, 1894, XXVIII, 2, 296.

[4] *Zeitschr. f. klin. Med.*, 1907, LXII.

[5] *Boston Med. and Surg. Jour.*, 1904.

there is the same tendency to form adhesions, contraction of the joint appendages and surrounding muscles which we meet with in the other forms of joint infection.[1]

Gonorrheal Osteo-arthritis. — The pathology of gonorrheal osteo-arthritis exactly resembles that of all the other infectious osteo-arthritides of the septic type. In the beginning there is either a focus with an area of rarefaction surrounding it, or there is a diffuse infiltration of the articular end of the bone. In either case, the infection may spread directly to the joint surface, when the cartilage degenerates in part or as a whole, and thus the infection invades the interior of the joint.

It is plain, therefore, that the joint involvement is secondary and not primary in osteo-arthritis, as has been heretofore supposed. This is well illustrated by those cases of osteo-arthritis in which the joint proper is never invaded at all. Aside from the reflex purely serous effusion the joint never becomes affected in these cases, and there may be complete resolution without loss of joint motion.

In all forms of infectious osteo-arthritis, the periosteum adjacent to the affected part undergoes proliferation. The proliferated periosteum later becomes ossified, and thus are formed various forms of thickening, osteophytes, spicules, etc. These, of course, limit the joint motion more or less completely and permanently. They can always be seen in the radiograph.

If the infection invades the joint, the cartilage is more or less completely destroyed, and when there are foci in the adjacent bones (not an unusual occurrence) the joint is completely destroyed, with complete bony ankylosis as the final result.

Since bone rarefaction always appears within the first few days of an osteo-arthritis, and since it can always be demonstrated in good radiographs and never appears in arthritis at any stage, we have here a ready means for early differential diagnosis, and can with more or less certainty make a prognosis. It can be said with certainty that when the rarefaction is absent after the lapse of a week or ten days that we are dealing with an arthritis and therefore never will have bone destruction, bone overgrowth, or bony ankylosis. This is true even when we have a purulent exudation in the joint.

On the other hand, its presence is an absolutely sure sign that we are dealing with an osteo-arthritis. In these cases we are sure to have bone destruction and more than likely to have permanent disability. It is not, therefore, mixed infection which causes the very serious forms of gonorrheal joint disease with bone destruction, but the fact that we have a primary bone focus to deal with which leads to these serious consequences.

Clinical Types.—The onset may be acute or subacute. If acute, the inflammation begins like an attack of acute articular rheumatism, with

[1] This and the following quotations are from Nathan, *N. Y. Med. Jour.*, March 16, 1907, p. 501.

pain, redness, swelling, tenderness, and disability. But there are no sweats; the brilliant redness and exquisite sensitiveness of acute articular rheumatism are not seen, and fever, if present at all, is relatively slight.

A subacute onset varies in intensity from a mere ache with local tenderness to a moderately severe pain with some swelling and considerable disability.

The duration of the inflammation is characteristically prolonged, although exceptionally an intense attack is brief. The mildest lesion may hang on for weeks and months. Moreover, certain cases show a marked tendency to relapse of joint symptoms with each new attack of gonorrhea. Fournier and Keyes, Sr., have each recorded an instance of four such relapses in a single patient, and Brandes has seen six.

The *severity* of the inflammation is moderate as compared to other types of septic arthritis. There is more or less thickening of the soft tissues, and usually no great exudation within the joint. Yet in exceptional instances the joint may be filled with a purulent exudate and be the cause of intense sepsis.

Complications.—The complications due to direct extension from the joint are bursitis, tenosynovitis, and infiltrations of the surrounding tissues. Abscess outside the joint, as in the case reported by Ware,[1] is even rarer than suppurative arthritis. Implication of the bone is, as stated above, primary and not secondary.

The results of gonorrheal arthritis depend upon the treatment and the nature of the lesion. Osteo-arthritis may even result in total destruction of the joint with bony ankylosis. The worst that simple arthritis can do is to cause fibrous ankylosis. The most discouraging features of the prognosis are the marked tendency to chronicity, the totally indefinite duration, and the tendency to relapse after apparent cure.

Diagnosis.—The diagnosis of acute gonorrheal rheumatism occurring during the course of gonorrhea is not difficult. Under these circumstances marked swelling in a joint, with slight constitutional disturbances, is very suspicious, while if the onset is sudden, the pain intense, and the para-articular swelling marked, the diagnosis is positive. This para-articular involvement gives the swelling a characteristic fusiform shape.

Acute gonorrheal rheumatism occurring in the absence of perceptible urethral lesion (as in the children reported by Kimball) can only be diagnosed by the discovery of the gonococcus in the fluid aspirated from the joint. But this fluid, whether serous, sero-fibrous, or purulent, may be quite sterile. Indeed, innumerable observations prove that the ab-

[1] *N. Y. Med. Jour.*, January 13, 1906.

sence of gonococci in the joint fluid, whether tested by smear or by culture, is no evidence against gonorrhea.

Chronic gonorrheal arthritis is far more difficult of diagnosis. Nathan insists that though gonorrheal arthritis may be recurrent, it is never really chronic, and that the cases called chronic "are those in which the initial acute inflammation has left behind bands of adhesion or other structural change in the synovial membrane in arthritis, and bone outgrowths or ankylosis in osteo-arthritis. These changes, unless treated mechanically or by operation, are permanent."

That this is not strictly true is shown by the cures resulting from serum and toxin treatment. Yet in the main it is undoubtedly true. The diagnosis here is suggested by the history and can be proven only by the response to specific treatment.

The most important point in the diagnosis, however, is the discovery of lesions in the articular ends of the bones. For this we depend upon radiography.

Prophylaxis.—Among the gonorrheal patients I have treated from the onset of their disease not one has developed systemic gonorrhea. This is in a measure the dispensation of a kind Providence, but it is primarily a result of the proper treatment of the disease in its early stages. The local treatment of acute gonorrhea almost certainly prevents systemic gonorrhea.

The injection of toxins at the first appearance of the fever in the course of a gonorrhea also has a distinctly prophylactic effect.

Curative Treatment.—Inasmuch as acute gonorrheal arthritis is but one lesion in a general systemic infection, the patient should be considered septic and the possibility of further systemic gonorrhea should be recognized. He should be put to bed and *the urethral source of infection vigorously attacked.* This is essential in order to rid him of his focus.

The joint should be immobilized and Bier hyperemia employed throughout the acute stage. A light plaster-of-Paris bandage or splint affords the best immobilization and does not interfere with the Bier treatment. The patient should not be permitted to use the affected limb before the acute inflammation has subsided, however mild this be.

The one way to prevent permanent changes in and about the joint is by careful local treatment during the acute stages. The beneficial effect of the Bier treatment cannot be doubted.[1]

The specific toxins and sera afford much relief (p. 105). One or the other should always be employed. "Hot-air" baking[2] has much the same effect as the Bier treatment.

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[1] Cf. Bier, "Hyperæmia als Heilsmittel." Baetzner, *Deutsche Zeitschr. f. Chir.*, 1907. Von Tiling, *Jour. Am. Med. Assoc.*, April 29, 1905, p. 135.

[2] Wagner, *Med. klin.*, IV, June 21, 1906.

If the tension within the joint is not promptly relieved by immobilization and passive hyperemia, the fluid should be aspirated. The presence of pus in the joint is not of itself an indication for more vigorous surgical measures, for it is likely to be spontaneously absorbed. But if the pus persists, or if the temperature and the general conditions show that absorption is taking place, arthrotomy should be performed and the joint irrigated with 1:2,000 nitrate-of-silver solution.

As the acute symptoms subside the diagnosis should be accurately made between arthritis and osteo-arthritis. The former requires that the immobilization be prolonged and passive motion begun cautiously, the latter that passive motion should be begun early, before the splint is left off, and that massage, passive motion, and splints be used until function is entirely restored.

Bier's hyperemia and baking are useful. Fuller's [1] operation of vesiculotomy for gonorrheal rheumatism I have not tried. He claims 17 cures and no deaths in 23 cases treated.

Rare Complications of Gonorrheal Arthritis.—Gonorrheal tenosynovitis is a relatively frequent complication of gonorrheal arthritis. It may occur near an inflamed joint or at a distance. Among the rarer complications may be mentioned myositis, bursitis, perichondritis, intramuscular or subcutaneous abscesses, adenitis. These also usually occur in the region of an inflamed joint, but may appear at a distance.

GONORRHEAL ENDOCARDITIS

Systemic gonorrhea produces heart lesions in from 10 per cent to 20 per cent of cases. Thus Nolan recognized heart lesions of probable gonorrheal origin in 16 out of 115 cases of gonorrheal arthritis and Sears [2] in 25 out of 167.

Sears has analyzed 68 cases of gonorrheal endocarditis, of whom 61 were in men, 7 in women. The heart lesion was associated with arthritis in 56 cases, in 48 of which the lesions involved three or more joints, while in 10 there were no joint lesions. The heart was involved during the first gonorrhea certainly in 31 cases, probably in 9 more. In one instance the heart is alleged to have been involved during the second day of a gonorrhea. As a rule the lesion was first noted during the fifth or sixth week.

Pathology.—The lesions are usually confined to the heart valves. Exceptionally there is pericarditis and even myocarditis. Sears says: "In 38 cases the mitral valve above was involved, in 12 the aortic, and in 2 the pulmonic. The mitral and aortic were both involved in 8, the mitral and tricuspid in 1, the aortic and pulmonic in 1."

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[1] *N. Y. Med. Jour.*, May 30, 1908. [2] *Boston City Hosp. Reports*, 1898, IX, 201.

The pathologic changes [1] in the valves usually consist in small friable vegetations made up of plasma cells, leukocytes, and red blood-corpuscles in a loose framework. Sometimes the valve is exulcerated, even perforated. Gonococci may usually be cultivated postmortem from the lesions and sometimes antemortem from the blood.

Clinical Types.—Two clinical types are recognized, viz., simple gonorrheal endocarditis and malignant gonorrheal endocarditis. Neither type shows any clinical peculiarity to stamp it as gonorrheal. The former is mild and insidious in onset, perhaps entirely latent, so that the resultant murmur, perhaps recognized years after, may be the only symptom. The malignant type, on the other hand, usually begins abruptly with chill, and progresses with intense septic fever. Yet the types are neither fixed nor exclusive; a case may begin mildly and become malignant later, or, beginning in the most acute fashion, it may rapidly subside.

Diagnosis.—A patient who develops a heart murmur or malignant endocarditis while suffering from gonorrheal rheumatism may be put down as a case of gonorrheal endocarditis. A more accurate diagnosis during life is possible only in those malignant cases from whose blood the gonococcus may be cultivated, and they are very few.

Postmortem the gonococcus is often, though not always found in the lesions on the heart valves.

Prognosis.—Sears believes that a mitral lesion offers a better prognosis than any other, since of the 43 cases in his series that recovered, 33 gave signs of lesions in that valve.

Cardiac symptoms, if present, usually persist a month to six weeks, septic symptoms two to four weeks. The damage to the valve is usually permanent and the murmur persists. Fatal cases usually terminate in two or three weeks, but the patient may survive several months. The proportion of cases that die cannot be accurately estimated, since the diagnosis in many of the survivors remains doubtful.

Treatment.—The treatment is that of endocarditis plus the antigonococcus vaccine or serum.

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[1] Cf. Rosenthal, *Berl. klin. Wochenschr.*, November 26, 1900; Thayer and Lazaer, *Jour. of Exper. Med.*, 1899, IV; and Thayer, *Am. Jour. of the Med. Sci.*, November, 1905.

CHAPTER X

OCULAR GONORRHEA

It is convenient to group in one chapter infectious gonorrheal conjunctivitis and the ocular lesions of systemic gonorrhea, though the relations between them are anatomic and biologic, but not clinical. The gonococcus does not invade the system from the conjunctiva.

INFECTIOUS GONORRHEAL CONJUNCTIVITIS

The frequency of gonorrheal conjunctivitis in infants and its rarity in adults has been mentioned in Chapter VIII.

The infection is due to contact with gonorrheal pus, derived from the mother's genitalia during parturition or, in after life, from contact with dirty fingers.

Symptoms.—The incubation period is believed to be from twelve to forty-eight hours in adults. In infants the inflammation first shows itself on the third or fourth day. In adults one eye is usually spared if properly protected, but in infants the lesion is commonly bilateral.

The onset is hyperacute, as a rule. Conjunctival redness, with serous exudate and lacrymation, progress in a few hours to intense redness, with subconjunctival exudation and purulent secretion. The subjective symptoms of burning and itching are exchanged for intense and constant pain. The lids are intensely red and swollen. They must be forced apart to obtain a view of the eye. The ocular conjunctiva is intensely inflamed and so swollen that it overhangs the cornea, which thus seems sunk into the depths of the globe. The subconjunctival edema interferes with the circulation of the cornea, which is usually more or less necrosed. This corneal necrosis or ulceration, if situated near the periphery, may be concealed during the acute attack by the overhanging conjunctiva.

The pain completely exhausts the patient, but there is no fever.

The corneal destruction results in opacities which, if central, destroy the vision. Perforation of the cornea results in prolapse and involvement of the iris. Iritic adhesions may occur even when there is no perforation.

In some instances the disease progresses with relatively little superficial suppuration, but marked involvement of the subconjunctival tissue.

Prognosis.—The infection, though rarer, is usually much more severe in adults than in infants. The sight of an adult is rarely saved, that of an infant often is.

The duration of the acute disease is from two to six weeks, a mild conjunctivitis persisting as long again. It may leave a pseudo-trachoma. Corneal destruction is often far less than would be expected from the intensity of the inflammation. Glaucoma may supervene in a badly damaged eye.

If an eye is destroyed by gonorrheal or other purulent inflammation the danger of sympathetic inflammation of the opposite eye is very slight, if it ever occurs (Knapp). It is not, therefore, proper to remove the stump for fear of this dreaded complication, a fact well to bear in mind, because a shriveled stump of an eye furnishes a better base of support for an artificial eye than does enucleation or its substitutes.

Diagnosis.—Almost every acute purulent conjunctivitis is gonorrheal and almost every gonorrheal conjunctivitis is purulent. The microscope determines the diagnosis. There is a pseudo-gonorrheal conjunctivitis neonatorum of relatively mild type, not uncommon in institutions.

Prophylaxis.—An antiseptic should be dropped into the eyes of every child at birth. There are no exceptions to this rule of practice. The antiseptic usually instilled is 2 per cent silver nitrate, as advised by Credé.[1] But Cragin[2] has shown that the resulting "silver catarrh," which can be eliminated by using a 1-per-cent solution, but only at the expense of decreased efficiency, may be eliminated by the use of 20 per cent argyrol. This he considers the ideal prophylactic. The argyrol must be freshly dissolved.

The adult exercises prophylaxis by keeping his fingers clean and out of his eyes. I have never known a case of gonorrheal conjunctivitis in my private practice.

Curative Treatment.—Mild purgatives and a light diet are of advantage at first. Perfect rest of body, and, if possible, of mind, should be secured. The sick-room should be obscurely lighted. If the patient is not robust no depleting measures are allowable, and the laxative, if any be given, must be light, while the diet must be supportive, even stimulating, when the condition is low. Under all diet rules lies the general principle that the strength must be fortified, for there are on record cases of children who in the period of recovery acquired summer diarrhea, and at once suffered an aggravation of inflammation of the cornea which, by regulation of diet and arrest of diarrhea, immediately improved.

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[1] Cf. *Jour. Am. Med. Assoc.*, March 13, 1909, p. 876.

[2] Trans. Am. Gynec. Soc., 1907.

Local treatment must be properly instituted. Delay may jeopardize the eye. The essentials of treatment are three:

1. Antiphlogosis: Cold.
2. Cleanliness: Irrigation.
3. Antiseptics: Bactericides.

The greatest possible care is necessary in handling the tender swollen eye. No pressure is allowable. Two or three skilled nurses are essential.

All dressings should be the lightest possible, and tenderly placed by a delicate hand. The swollen upper lid is already weight enough. The utmost care should be used in protecting the sound eye from contagion. Buller's shield, a watch glass set into perforated squares of rubber plaster, is not so good as Knapp's suggestion, a mica spectacle plate (to be obtained from any optician) fastened on with rubber plaster strips. This is transparent, very light, and does not steam.

All operative measures are categorically contraindicated during the active period of the disease. Cantholysis, scarification, aspiration of the anterior chamber, and amputation of the prolapsed iris are alike harmful.

Cold applications are of the utmost importance. Their application must be unremitting night and day, and for this reason two or even three trained nurses are necessary. Thin compresses, chilled in ice water, should be placed upon the closed lid, being renewed about every five minutes night and day. The cold must not be too intense during the decreasing stage, as it may interfere with the nutrition of the cornea—an interference which manifests itself by a misty appearance commencing at the center of the cornea. Should this be noticed, the cold applications must be stopped at once.

Cleanliness and drainage must be constantly assured by gently separating the lids and freely instilling with a dropper or an irrigator (not a syringe, for fear of spattering the pus into the eye of the attendant), either 4 per cent boric-acid solution, or 1 : 20,000 permanganate-of-potash solution. These applications are made freely to the entire conjunctival sac about every two hours, or even oftener if the pus be very abundant.

They are continued less and less frequently until the discharge is no longer purulent.

Antisepsis.—The organic compounds of silver are as useful in ocular as in urethral gonorrhea. Argyrol is the salt commonly employed, a few minims of a 20-per-cent solution being dropped into the inflamed eye every half hour or every hour until the acute inflammation begins to subside and the discharge becomes muco-purulent. Thereafter 2 per cent nitrate-of-silver solution is applied with a camel's-hair brush once or twice a day until gonococci can no longer be found in the secretions.

SYSTEMIC OCULAR GONORRHEA

The various lesions that may occur in the eye as a result of systemic gonorrhea are enumerated as follows by Byers [1]:

Iritis (Mackenzie), conjunctivitis (Fournier, 1866), iridochoroiditis (Koeniger, 1872), keratitis (Colsmann, 1882), panophthalmitis (Martin, 1882), optic neuritis (Panas, 1890), dacroadenitis (Panas, 1894), retinitis (Burckhardt, 1894), tenovitis (Puech, 1895), thrombosis of the retinal vessels (Galezowski, 1900).

Iritis and Iridocyclitis.— The lesion is not very common. Lapersonne saw one or two cases among 2,000 eye cases and Kurka two in 20,000. In Byers's cases it was always preceded (62 cases), accompanied (9 cases), or followed (10 cases) by gonorrheal rheumatism. It was unilateral in 48 cases, bilateral in 23 in the first attack; unilateral in 16, bilateral in 3 in relapses.

Byers recognizes the following types: Iridocyclitis (mild or severe), plastis iridochoroiditis (which may exceptionally proceed to suppuration), exudative, relapsing, and hemorrhagic iritis.

The lesions are not clinically distinguishable from similar lesions due to other cause except by the concurrence of genital and joint gonorrhea.

Conjunctivitis.—The lesion was bilateral in 42 cases, unilateral twice. In 35 per cent there were other ocular lesions, usually keratitis.

The symptoms are rather mild, the secretion usually mucoid or mucopurulent. There was conjunctival edema in half the cases, swelling of the lids in only 10 per cent. Both ocular and bulbar conjunctivæ were usually involved. Gonococci were found in the discharge in many cases. The average duration was two weeks, with five and forty-six days as extremes. Relapses were rare and the prognosis good.

Retinitis.—The lesion is neuro-retinitis (bilateral six times, unilateral five times). Six of Byers's cases recovered and three terminated in atrophy.

Other Lesions.—The other ocular lesions of systemic gonorrhea enumerated above are rare and occur as complications of iritis or conjunctivitis.

Diagnosis.—The diagnosis of these lesions as gonorrheal depends almost solely on the concurrence of genital gonorrhea and gonorrheal arthritis. Iritis without arthritis during gonorrhea could not be considered more than suspect.

The discovery of gonococci in the secretion from the inflamed conjunctiva proves the nature of the lesion, but may leave doubt as to

[1] "Gonorrheal Ocular Metastases," Montreal, 1908. The statistics throughout are from this monograph. In each case the name of the discoverer and the date of discovery are placed in parenthesis.

whether gonorrheal conjunctivitis is sytemic or local. Systemic conjunctivitis is likely to be mild, bilateral, and accompanied by other ocular lesions; it is always associated with genital gonorrhea and gonorrheal arthritis. Local, virulent conjunctivitis, on the other hand, is not associated necessarily with any other lesions of the disease, and is usually an intense, unilateral inflammation.

Treatment.—Instillation of 10-per-cent argyrol solution every three hours is of benefit for systemic conjunctivitis. Other local treatment is along general lines; e. g., atropin for iritis, etc.

The urethra must be vigorously attacked, as in every type of systemic gonorrhea.

The toxins or serum should be administered, though they have not proven so successful in the treatment of iritis as in that of arthritis.

CHAPTER XI

GONORRHEAL VULVO-VAGINITIS IN CHILDREN

By Dr. E. D. Barringer

This disease is generally found in the children of the poorer classes, where overcrowding and unhygienic surroundings predispose to its transference. Dirty towels, soiled linen, etc., are the usual media of contagion; often a direct history can be traced through the mother who is unaware of the nature of her leucorrhea to the father who has an active gonorrhea. Trentwith [1] states that 50 to 75 per cent of his cases showed the father to be indirectly responsible for the infection.

In hospitals, asylums, and especially nurseries, an epidemic is often due to lack of recognition of the nature of the discharge and carelessness in handling it.

Such epidemics in institutions may usually be traced back to one or two children. Sheffield showed that one little girl with vulvo-vaginitis conveyed the infection through the medium of a large bath tub, in which twenty to thirty of the children had been bathed at one time.

Though epidemics of gonorrhea in children occur in the above stated manner, many individual cases are due to rape. In the crowded tenement districts, especially the Italian, this is not an infrequent occurrence, probably arising in many cases from the prevalent superstition that coitus with a virgin will cure an attack of gonorrhea.

Yet this infection is by no means confined to the children of the poor. Oftentimes most virulent and intractable cases have been found in a fashionable girls' school, or in the home of luxury, where the disease has occasionally been traced back to the erring nursemaid.

The prevalence of this infection among children has been estimated in various clinics where these children have been brought for treatment. Welt-Kakel [2] reports that in ten years, 1893–1903, in her service at the Mount Sinai Hospital Dispensary she had 190 cases (1.6 per cent) of vulvo-vaginitis among a total of 11,578 cases treated. She further states that " Pott mentions 1 per cent, while Henock found 1 in 1,500 children.

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[1] *N. Y. Medical Journal*, February 3, 1906.

[2] *N. Y. Med. Jour.* and *Phila. Med. Jour.*, October 8–29, 1904.

The statistics of the Armenkinderspital in Pesth shows a percentage of 0.7 per cent among 32,875 children; at the Armenkinderspital in Graz, 15 cases of gonorrheal vulvo-vaginitis were found in the year 1890 in a service of 4,501 children, while Seiffert found among 3,414 sick children at the Polyclinic 22 cases." Dr. Welt-Kakel states her cases did not occur epidemically, but were isolated cases which presented themselves during her service.

Morbid Anatomy and Pathology.—The organ most usually involved in children is the vulva.

The vagina also is usually involved, and the area of greatest inflammation is at the vaginal outlet, around the hymen, where the gonorrheal discharge passes over the perineum.

The gonococcus rarely burrows beneath the deeper layer of the epithelium.

The gonococcus is usually found in the discharges.

Symptoms.—The incubation period of gonorrhea seems, on the whole, to be of shorter duration in children than in the adult; three to four days is the time given by Cohena-Brach and Luczny (Welt-Kakel).

The child first complains of pain on walking, or of a burning or "itching" on urination, and the mother notes a discharge.

There is usually considerable edema of the labia majora, which are more or less stuck together with the copious purulent discharge which pours out from the vagina. Underlying the dried discharge there are often erosions, which bleed easily—the inflammatory condition may extend to the skin surrounding the vulva and affect the inner aspects of the thigh. And there is often an accompanying inguinal adenitis.

On gently separating the labia pus is usually found oozing through the vaginal outlet. If the pus be wiped away and the child cry or cough, often more pus will be expressed through the opening, showing that the vagina is involved.

In cases due to violation the accompanying trauma may be very considerable—the hymen may be ruptured or the whole perineal floor torn through. In one such case observed by me the traumatism was so extreme that the whole perineum was destroyed and the vulva black and gangrenous appearing. (The child in this instance was in shock when first seen.)

In many cases of violation there has not been any penetration and the hymen may be quite intact. Bandler states that by playing a stream of water under mild pressure against the hymen the delicate, fringelike edge can be examined to see if an injury has been inflicted.

By inserting a very small Ferguson speculum (modification by Bandler) or a Kelly speculum No. X, with the child in the knee-chest position, the vagina can be entirely examined, and the cervix brought into view and inspected as to discharge.

In the ordinary uncomplicated cases of vulvo-vaginitis there is, as a rule, only a slight, if any, elevation of temperature, and but mild constitutional disturbance.

Diagnosis.—The finding of the gonococcus in the discharge establishes the diagnosis. In view of present uncertainties in regard to the bacteriology (of vulvo-vaginitis) it would not seem sufficient to base a diagnosis on a smear showing a Gram negative diplococcus. Before pronouncing a final diagnosis a culture should be made. This should be insisted upon in cases of possible medico-legal import. A sufficiently accurate working diagnosis for clinical purposes, however, can be made by the finding of the Gram negative diplococcus in a smear taken from a given case.

Differential diagnosis must be made from noninfectious vulvo-vaginitis, which arises from a variety of causes, such as lack of personal cleanliness, soiled diapers, decomposed smegma, sweat, urine, the oxyuris, or pin-worms from the rectum. In hot weather, and especially with exercise, these conditions arise more readily.

There is also the so-called "catarrhal" form of vulvo-vaginitis, which clinically resembles gonorrhea, but does not show the gonococcus; the bacteriology of this other still seems to be obscure. This form, however, is infectious.

Noninfectious vulvo-vaginitis may complicate some of the infectious diseases; e. g., measles and scarlet fever.

Course of the Disease.—The acute inflammatory stage usually lasts from four to six weeks. After this the discharge is apt to change in character from a profuse thick to a thin serous flow and the case to become subacute or chronic. The duration of the disease varies greatly; many cases extend over a number of years. The average time for cure has been variously estimated at four to six months.

In children as in adults gonorrhea is prone to relapse. Often after an apparent cure the trouble starts up suddenly, and gonococci reappear in the discharge.

Complications.—The complications of vulvo-vaginitis are very numerous. Though extension of the infection to the bladder is rare in children, Wertheim has reported a case of true gonorrheal cystitis in a little girl, where the gonococcus was found in a piece of bladder mucous membrane removed by an operating cystoscope.

Extension of the infection from the cervix through uterus and tubes on into the peritoneum may give any of the surgical complications which the gynecologist finds in the adult, as salpingitis pyosalpinx, or purulent peritonitis. These cases are often diagnosticated as appendicitis, but examination of the vaginal secretion usually reveals the gonococcus. The course of a pure gonorrheal peritonitis is usually more favorable than that of a mixed infection.

Extension of the gonorrheal process to the anus and rectum may take place. Arthritis is one of the more frequent complications; gonorrheal conjunctivitis also. In fact, any of the systemic manifestations of gonorrhea may occur. Sequelæ are usually adhesions of the uterus, tubes, and ovaries.

Treatment.—In the early stages, while there is edema of the vulva and profuse discharge, it is preferable to keep the child in bed. The mother or nurse should be instructed in the careful handling of all infectious materials.

The diet should be light, avoiding any highly seasoned food and plenty of fluid should be taken. The bowels should be kept freely open. Once or twice a day the child should be put in a warm sitz bath.

If the discharge is confined to the vulva or is very profuse there, it is well at first to confine the irrigations to the vulva only.

The degree of vaginal involvement can be fairly well estimated by the method mentioned above—wiping away the pus over the vaginal opening and observing if more pus oozes down when the child cries or strains.

The irrigation used for the vulva should be copious hot flushings of a 2-per-cent boric-acid solution while the inflammation is very acute. This should soon be changed to a bichlorid-of-mercury (1: 10,000–5,000) solution, lysol (½ to 1 per cent) or potassium permanganate (1–2,000).

If the vagina is obviously badly involved from the first, vaginal douches should also be given without delay, the above solution (slightly diluted) being used, and two quarts used at a time.

The best douche outfit is a soft-rubber catheter, No. 15, F., attached to a glass irrigating jar or ordinary fountain bag. The pressure should be mild.

The child is placed in the dorsal position over a Kelly pad douche pan. The catheter should be introduced with great care so as not to injure the delicate hymen. The douches should be given twice or thrice daily, oftener if needed to wash away the discharge.

After each douche the vulva should be gently dried and [1] ointment applied so as to protect the delicate skin from the excoriating effect of the discharge.

A light absorbent vulva dressing should be applied and held securely in place between treatments so as to avoid any conveyance of pus to the eyes by means of the child's fingers.

After the first acute stage is over, the vulva should be painted thor-

[1] Zinc oxid ointment has been found by some to be very useful for this purpose; others recommend an ointment containing one of the silver salts as a 2-per-cent protargol ointment (Bandler). The writer has found the use of these silver ointments to be most efficacious.

oughly with argyrol 5 to 25 per cent, protargol 2 to 4 per cent, or silver nitrate 1 per cent. The vagina should also have instillations of any of these solutions, treatment to either vulva or vagina being given once a day immediately following the douching. The instillations into the vagina can be made readily by the use of a glass medicine dropper.

Gradually the daily treatments can be changed to thrice and then twice weekly. If the vaginitis persists, it may be necessary to give direct applications to the vaginal or cervical mucous membrane.

These applications should be made with the child in the knee-chest position and by means of a small Ferguson or Kelly No. X speculum. The hymen should be anesthetized by a pledget of cotton soaked in 2 per cent alypin, which is allowed to remain there for five to ten minutes. Light is thrown in by means of a hand mirror and the cervix or vagina examined carefully.

Erosions of the cervix or vagina can be touched up with a 3- to 5-per-cent silver-nitrate solution, and if the vagina is extensively involved it may be filled with a 1-per-cent silver-nitrate solution, which is allowed to remain there for a few minutes.

As improvement takes place the silver irrigation can be replaced by zinc-sulphate irrigation (solution of about $\frac{1}{8}$ per cent strength) or zinc and alum (3j) to water (Oj).

From time to time the discharge should be examined for gonococci and active treatment continued so long as these are found.

When the discharge no longer shows them and the flow ceases a tentative cure may be pronounced and treatment stopped.

In view of the tendency of the recurrences, it is wise to reëxamine at intervals of months and later every year or two. Of course this is only practicable where the physician has the coöperation of an intelligent parent or guardian.

Prophylaxis.—The safeguarding of children of the community from the ravages of gonorrhea seems so vital a duty that it is only necessary to mention the more important ways in which this can be furthered.

All adults in active gonorrhea, especially those who have children, should be warned of the great infectiousness of the disease and that little girls are apt to contract it. Specific instructions should be given in regard to the destruction of all soiled dressings, proper disinfection of hands, and importance of separate sleeping and toilet arrangements.

Violation is a crime which should be followed up more severely by the hand of the law. It should be a matter of civic responsibility to see that these cases are brought to justice. And yet one familiar with the tragedies of the slums often sees these cases sink into oblivion with no questions asked.

In hospitals, asylums, day nurseries, or institutions where children are congregated, the utmost care should be taken in regard to the admis-

sion of children with leucorrhea. Many of the leading hospitals at present will not admit a girl to their children's wards without taking a vaginal smear.

When gonorrheal vulvo-vaginitis has once gotten into such an institution the most careful and intelligent isolation and treatment should be carried out.

If possible such cases should be isolated as completely as measles or scarlatina. Where separate nurses are not possible, extra precautions should be taken to insure asepsis in going from one case to the next. All thermometers, towels, douche outfits, bath tubs, and toilet articles should be kept separate for these cases and should be scrupulously disinfected before and after using. The nurses should be especially instructed in the disinfection of their hands and be provided with rubber gloves if possible. Where the babies are still in the diaper age, gauze dressing, which can be destroyed, should be substituted. Diapers or dressings of any kind which are used again should be most carefully boiled and steam sterilized if possible.

Dr. Holt has drawn attention to the fact that one of the most trying features about prophylactic measures is the length of time they must be persisted in.

CHAPTER XII

GONORRHEA IN WOMEN

By Dr. E. D. Barringer

There is probably no infection which appears in a greater variety of forms to tax the skill and judgment of the medical practitioner than gonorrheal infection in the female. Its almost infinite variety of clinical pictures, its frequently obscure onset, its insidious progress make it often difficult of diagnosis. Again, the sociologic questions which accompany this infection still further complicate the problem of treatment.

It is of importance to consider some of the causes which have combined to make this infection in the female sex so much more of an elusive factor to deal with than in the male. Foremost of these is the actual anatomical difference in the conformation of the genito-urinary organs of the two sexes.

In the female the extent of mucous membrane which may be involved is enormous in comparison with the male. The vulva with its intricate folds, the urethral orifice with its glands, the vagina and cervix, around which the gonococci are usually deposited, the uterus with its endometrium rich in glands, the Fallopian tubes, the ovaries, to the peritoneum, present one continuous trail for gonorrheal invasion.

Again, as this disease practically always results from sexual intercourse, and frequently from illicit intercourse, the question of gonorrhea has gone hand in hand with the history of prostitution. The sociologic problems surrounding prostitution are necessarily intricate. Man and woman hold entirely different positions in regard to it. The man who transgresses has but little thought, other than perhaps a preliminary burning of conscience, of the moral side of the transgression. His one thought is to seek consultation in order to rid himself of the disease, and when cured he is no better nor worse than the small percentage of his fellows who have not transgressed. He belongs to the majority.

On the other hand, the woman who transgresses is an outcast. Her one thought is neither to seek advice nor consultation, but to hide everything.

The causes for these two points of view are probably on the one hand man's aggressive nature, his ability to create public opinion, and on the other hand woman's passive acquiescence to these created standards.

It is this man who has transgressed, who has had experience, who marries. Therefore, when any question of gonorrheal infection comes up after marriage his experience is pitted against his wife's ignorance in disguising the real condition of affairs. And if strange and overwhelming disease comes to the woman after marriage, not realizing what causes might be responsible, she has been taught to believe that this suffering is woman's portion and has accepted her lot. That woman is monogamous by instinct has not a little to do with this point of view.

Not so with the man; if he has reason to believe he may have gonorrhea, at the outset of the first symptoms he consults a physician and the physician must be ready with prompt and efficacious treatment if he would hold this patient. Out of this situation have arisen numerous methods or schools of treating acute gonorrhea in the male, and this treatment has reached a stage of great perfection, because the demand for such treatment has been insistent.

With his female patients the physician has been put under no such pressure for diagnosis, and while he has achieved lasting fame in the treatment of the later surgical complications of gonorrhea in the female, he has often gone in the line of least resistance in making a diagnosis of gonorrhea in its early stages. The woman, not suspecting what may be at the bottom of her slight indisposition, has too often been reassured by the statement, "Oh, the discharge is only the result of marriage relations." "You have taken a slight cold in your bladder," etc. She goes home and neglects herself, and returns to her physician only when symptoms have sufficiently asserted themselves so that he can make a *clinical* diagnosis of gonorrhea. As a result many a case of acute gonorrhea in the female is grossly mishandled and swells the lists of those cases later demanding surgical skill.

When, therefore, the possible gonorrheic presents herself for consultation, the conscientious examiner must tactfully approach his task and attempt to find out in which one of the following classifications this particular woman belongs.

First: Is she a married woman who has innocently contracted the disease, knowing nothing of its nature? If so, the economic question of not destroying the marriage relation presents itself.

Second: Is she an unmarried woman who has contracted the disease as a result of illicit intercourse? If so, is she a "first offender," unaware of the enormity of what she has done, or is she a prostitute?

Third: Is she an unmarried woman who is quite innocent of any sexual relations, and has had the misfortune to contract the disease by the use of infected linen, toilets, douche outfits, or dirty instrumentation?

Fourth: Is she perhaps one of the victims of a former infant gonorrhea?

Fifth: If the patient be a little girl, has she become infected from some unrecognized source in her own family?

The importance of a correct diagnosis at once becomes apparent:

1. For the safety of the family or community. If the innocent woman is infected she must be instructed how to take care of herself, as she may infect other members of her family or her own eyes. If the patient be a prostitute, she must be warned that she is in an infectious state.

2. In justice to the individual. It is only necessary to mention how important it is to know *what* germ is responsible for the infection. It may mean the ruin of an innocent woman's life to be labeled gonorrheic when an entirely different cause could be found on investigation.

3. For the purpose of intelligent treatment and prognosis.

ETIOLOGY AND PATHOLOGY

The various clinical manifestations of gonorrhea in the female vary in accordance with the following conditions:

1. The *virulence* of the infecting gonococcus.

2. The *resistance* of the tissues which are invaded.

3. Whether the original infection is a *mixed* infection; i. e., the pyogenic organisms are present as well as the gonococcus.

4. The *raising of the virulence* of the original infection by certain processes in the woman. (This accounts for many cases of so-called "one-child sterility.")

Döderlein [1] says:

Clinical experience and bacteriological investigations have given rise to the following important conclusions respecting the etiology and pathology of gonorrhea:

A wide patulous external urethral orifice in the male favors the entrance of the female secretion; so that one with such a urethral orifice may acquire gonorrhea, while another—later comer—may not acquire it.

Likewise in the female the anatomical conformation of the genitalia has an influence on the kind of gonorrheal infection; with a narrow vaginal outlet, virginal, the urethra is likely to become infected; and in a non-virginal vagina the infecting agent more easily comes in contact with the upper part of the vagina and cervix. Infection with acute gonorrheal pus causes in women a much more acute, stormy attack of ascending gonorrhea (Wertheim) than an infection with chronic, latent gonorrhea.

In labor the gonococci in the lochia become more virulent, which favors an ascending infection.

[1] Küstner, *Lehrbuch der Gynäkologie*, 1904, p. 389.

In marriage the two participants may become immune to each other's gonococci. So that it is not possible to have a further exacerbation of gonorrhea between these two. When a third person trespasses, however, it is possible that he may have an attack of acute gonorrhea, while neither the man nor woman have any manifest gonorrhea (Wertheim). Not every connection with a gonorrheic woman is followed by an infection, because in chronic gonorrhea the genital secretions can at times be free of gonococci. Marked irritation of the genitals, menstrual or puerperal secretions bring the gonococcus to the surface, and so raise the infectiousness of the woman. Under these conditions the symptomless gonorrhea of man can experience a recrudescence, and the man can through his wife be infected with a virulent gonorrhea.

In man, latent, i. e. symptomless yet infectious gonorrhea can, through excesses, especially those venereal (marriage) experience exacerbations and appear after a pauze of perhaps ten or twenty years.

The organs covered by pavement epithelium are more resistant to the gonococcus than those covered by cylindrical epithelium, and the organs therefore most frequently involved in the order of frequency are the urethra, cervix uteri, posterior vaginal vault (where the infected cervix comes in contact with the vaginal wall), the vulva, and the remaining portions of the vagina.

There are further certain spots of predilection where the gonorrheal infection is apt to settle and become chronic, i. e., Skene's glands and Bartholin's glands. At the opening of the ducts leading from Bartholin's glands two small reddened spots can be seen when the ducts are infected with gonorrhea. These spots are called the "maculæ gonorrhoicæ" (of Sänger [1]).

THE HISTORY OF THE CASE

By inquiring carefully into the history of a given case and the probable mode of infection much valuable assistance can often be gained.

Thus, if no history of sexual intercourse is obtained and it is found that the patient has been using toilet articles, towels, etc., which might be a source of infection, the inference may be made that the infection is chiefly external around the vulva, urethra, and vaginal outlet.

Again, as sometimes occurs in dispensary practice, if a history is given of attempted intercourse (rape) in which the act was not accomplished, a similar observation may be made.

Also in newly married women a history of incomplete intercourse may be obtained, and especially in cases where precautionary measures against conception are used, as withdrawal or the use of protectors, one may again expect a low infection around the vulva or vaginal outlet.

[1] *Centrlbl. f. Gyn.*, 1896, p. 1073.

SYMPTOMS

The patient usually complains of a profuse burning discharge and difficult burning micturition.

These two symptoms in a woman who has previously been well suggest at once a possible gonorrheal involvement, the more so if coupled with a history of any of the above-mentioned modes of infection.

Other subjective symptoms may be given, as, for instance, pain when walking or sitting, sense of fullness and weight in the groins, small of back, or at the vaginal outlet, or occasionally the patient may report a bloody urine if the bladder involvement is marked.

An examination of the affected parts will give the further objective symptoms necessary to make the diagnosis. The details of the first examination will vary directly with the history obtained, and the virulence of the infection as observed when the vulva is inspected.

If the history of a probable low infection has been obtained, and an acute condition of the vulva and urethral opening is found, a smear of the discharge should be taken by means of a sterile platinum loop for examination and no further examination made until the acute external inflammation has subsided. The patient should be kept in bed. (See Acute Urethritis.)

If the patient gives a history of a probable high infection and complains of pain in the region of uterus or tubes, and this is verified by abdominal palpation, a careful bimanual examination should be made at once, for the case may call for immediate surgical care.

Should the patient come with the history of a subacute or chronic infection, the following routine examination should be made: The patient should be instructed *not* to take a douche before submitting to the examination. In this way the characteristics of the discharge can be noted.

The vulva should be inspected carefully; oftentimes venereal warts are found around the anus or vaginal outlet. The labia majora should be spread apart and search made for the maculæ gonorrhoicæ at the openings of Bartholin's glands. By slipping the index finger into the vagina for about one half inch and placing the thumb over the macula, oftentimes an induration or abscess of Bartholin's glands can be palpated. Should any pus exude from the ducts a smear and culture should be made and laid aside for examination. Examination of the urethral orifice should next be made. If a free discharge of pus be found in the urethra, a smear and culture should be taken, and then the urethral orifice carefully wiped off, and an examination made of Skene's glands. Again, by passing the index finger into the vagina and running it up toward the bladder end of the urethra and then massaging the urethra toward its outer end, a tiny drop of pus can oftentimes be expressed for a smear and culture.

The vaginal outlet should next be inspected, and if a discharge is found to be coming down from above, a further examination should be made with a speculum.

When the examination is made, great care should be taken to cleanse the vaginal outlet of all discharge, so that no infection be mechanically carried from outside upward to the cervix.

When the cervix is well exposed by the speculum specimens should be taken from the discharge found around the external os. The cervix is carefully inspected and then the posterior vault of the vagina for any erosions of the mucous membrane produced by contact with the infected cervix.

After the speculum examination is completed, a careful bimanual palpation should be made. With reference to the condition of the uterus and adnexa, special note should be made as to the size, position, mobility, and *sensitiveness* of the uterus; as to whether the tubes are enlarged or tender and as to whether perimetrium or parametrium is involved. If an advanced or urgent condition of the pelvic organs be found, the case may have already passed over into the domain of surgical gynecology.

VARIETIES

Acute Urethritis

Urethritis is considered the most frequent form of gonorrheal infection of the female genitalia. This is probably due to the fact that in the beginning of the sexual act the labia majora are pushed apart by the glans penis, and the urethral orifice in this way is put on the stretch. The ducts of Skene's glands, lying inside of the urethral orifice, are then brought in direct contact with the infecting discharge from the male urethra, as is the lining epithelium of the female urethra. And as this epithelium is columnar, the infection readily takes place.

Symptoms.—The patient usually complains of an intense burning discharge at the urethra and a sense of burning or "sticking" pain on micturition. Sometimes there is a marked tenesmus or even retention if the patient is nervous. She may note that she passes a few drops of blood at the end of urination.

Examination generally shows an intensely reddened urethral opening, oftentimes with the swollen mucosa bulging out of the orifice, giving the appearance of a prolapse. Pus is seen oozing down over the mucosa. The orifices of Skene's glands may be conspicuous or they may not be demarcated from the rest of the violently congested mucosa.

Palpation of the urethra *per vaginam* (care being taken to carry none of the pus up with the examining finger) gives acute tenderness. Oftentimes the urethra feels like a cord under the finger.

Diagnosis is not difficult if a careful history has been elicited; a smear taken of the discharge should show gonococci. *Urethritis* following infection by catheterization can usually be excluded by the history and the absence of gonococci in the smear. *Urethritis* caused by the irritation of concentrated urine, chemical irritants, traumatism, or the exanthematous diseases can usually readily be excluded by the history.

Treatment.—Rest in bed and absolute cleanliness are essential in treating acute urethritis. The attendant should be warned of the infectiousness of the discharge and all soiled dressings destroyed. Three or four times a day the urethral orifice and vulva should be gently flushed off with copious hot irrigations of boracic-acid solution or bichlorid of mercury 1:6,000 or lysol ($\frac{1}{2}$ to 1 per cent). These irrigations can be given by means of a fountain syringe with the patient in the dorsal position on a douche pan. After the irrigation, the vulva should be covered with an absorbent pad. The diet at first should be mainly liquids—milk, broths, and nonirritating foods. Condiments and alcohol in any form should be absolutely forbidden.

The patient should be encouraged to drink large quantities of water.

If the irritability and tenesmus is marked, a urinary sedative should be administered, as:

℞ Potass. citrate ..... gr. xx;
Tinct. Hyoscyamus ..... ℥ss;
Aquæ .....q. s. ad. ℥j.
Sig. One dram every three hours.

As the most acute symptoms subside local applications should be made to the urethral opening after the irrigation has been used. Two to four per cent protargol freely applied by means of a swab, around the urethral mouth and openings of Skene's glands may be very helpful. Argyrol (10 to 25 per cent) can also be used. These applications can be made once or twice a day. A certain number of these cases respond promptly to treatment, and make an excellent recovery; but, unfortunately, many pass into the subacute or chronic state. As many cases of acute urethritis are combined with cystitis, it is often necessary at the outset to start bladder irrigations (see Acute Cystitis).

Chronic Urethritis

Usually a history of an acute attack is obtained, but occasionally the patient becomes aware of her condition only when it is subacute or chronic. The urethra may alone be involved or there may be an accompanying cervicitis or cystitis. The discharge in these cases show as a rule pus and epithelium cells and pyogenic organisms, the gonococcus often being found with difficulty.

Symptoms.—Frequency of urination is the symptom most often found. This frequency occurs during the day when the patient is in the upright position, and may also be complained of at night.

In milder cases the patient complains of an occasional "tickling" or "burning" on urination, and this may be very intermittent in character.

Examination.—By massaging the urethra through the vagina a thick muco-purulent secretion can be obtained. This, when examined microscopically, may be found to consist of epithelium and pus cells and no gonococci present. The urethra in these chronic cases is generally found somewhat indurated and tender on palpation. After the urethra has been emptied of its secretion and this wiped off, a more thorough massage over Skene's glands may bring a tiny drop of pus to each duct. Oftentimes the gonococcus will be found here when it has disappeared from the urethral discharge proper.

It may be of value to ascertain whether the anterior or posterior portion of the urethra is chiefly involved. By massaging first the anterior portion and later the posterior a rough estimate of the involvement can be obtained. Examination by the endoscope may show local areas of congestion and erosion in the course of the urethra.

Treatment.—The general treatment is the continuance of a simple diet without the use of condiments or alcohol. The internal drugs commonly used are the same as prescribed for male patients (see p. 208).

Local treatment is accomplished by the application of the various silver salts to the urethral mucosa. This can be done by means of a glass medicine dropper or by bladder irrigations (p. 196).

These treatments should be given three times a week, later twice a week. If localized erosions are discovered these should be touched up with silver nitrate (5 per cent) with the aid of the endoscope.

If this process is painful, it may be necessary to first anesthetize the urethra. This can readily be done by inserting a fine applicator wound with cotton dipped in alypin 5 per cent.

In certain resistant cases the application of urethral pencils is very useful. These are variously prepared, containing various medicaments, as silver nitrate, protargol, argyrol, ichthargen, or astringents such as zinc sulphate. Astringents are of great value in the later stages of urethritis.

These pencils have the double value of acting mechanically as a small sound to dilate the urethra. They should be lubricated with a sterile lubricant before inserting.

Complications.—If persistent involvement of Skene's glands continues long after the urethritis has been controlled, it may be necessary to split open these little glands; this can be done by means of a fine scissors under local anesthesia; the glands and duct should then be swabbed

out with carbolic acid (95 per cent), followed by alcohol, or with a strong 30- to 50-per-cent silver nitrate or silver stick.

Caruncles may form in the irritated and hypertrophied mucous membrane around Skene's glands.

Stricture of the urethra is relatively rare in women and should be treated by dilating with a female urethral sound. Care should be taken that the dilatation is not too great, as the urethral wall may easily be injured. Dilatation up to 28 to 30 F. is sufficient.

Cystitis

Gonorrheal cystitis or cystitis arising from catheterization (e. g., in post-operative retention) is more frequently seen in women than in men.

Catheterization should in all cases be followed by an antiseptic irrigation and the catheter of election is the glass one.

The symptoms, diagnosis, and treatment of cystitis are discussed in Chapter XXXII.

Acute Cervicitis

Next to the urethra, the cervix is considered the organ most frequently infected by gonorrhea.

There are two reasons for this: The cervical mucosa is columnar in type, therefore especially prone to gonorrheal infection; and secondly, during coitus the seminal discharge is poured directly over or around the cervix.

In a large percentage of cases the cervix and urethra are involved at the same time; it is rare to see a gonorrheal cervicitis without a urethritis, but the reverse is not true.

Symptoms.—There is generally a sense of fullness or weight in the region of the vagina and a discharge. If the body of the uterus is involved there may be considerable pain in the hypogastrium.

Examination shows the cervix much reddened and covered with more or less purulent discharge. A smear usually shows the gonococcus. On wiping away the discharge the mucous membrane may show bleeding points or erosions and the cervix may appear edematous.

Diagnosis.—Diagnosis must be made from the ordinary form of cervicitis such as is found with a laceration of the cervix due to childbirth; or cervicitis due to passive congestion, as in certain displacements and stenosis of the cervix.

Carcinoma of the cervix is differentiated by the examination of excised portions of tissue in doubtful cases.

Involvement of the mucous membrane in any of the exanthematous diseases can be differentiated by the presence of other symptoms.

Syphilitic mucous patches can also be excluded by the history and

clinical findings, although these cases are sometimes very puzzling and a double infection may be found.

The same is true of chancres and chancroids. The finding of the Spirochæta pallida or the bacillus of Ducrey may establish the diagnosis.

Treatment.—Some physicians are averse to douching in the most acute stages of cervicitis, as they claim that there is danger of negating the value of the acid secretion of the vagina which is a natural safeguard.

If the cervix is actually involved, it seems, in the opinion of the writer, better judgment to keep mechanically removing the constantly accumulating discharge than to allow it to remain in contact with both the affected and unaffected mucous surfaces.

Therefore copious hot irrigations of a mild antiseptic solution are advised, under low pressure, so that there shall be no driving of the discharge farther up into the cervix.

Boric-acid solution (2 per cent), lysol (1 per cent, bichlorid of mercury (1: 5,000 to 10,000), permanganate of potassium or creolin ($\frac{1}{2}$ per cent) are used. These irrigations should be given two or three times daily or oftener if the discharge is very profuse.

Chronic Cervicitis

This may follow an acute attack, or the onset may have been so chronic in character that the patient has not been aware of its existence. The history is often of very little value, and the diagnosis, even after a most careful examination, may only be presumptive, unless perhaps some complication (as salpingitis) arises, which proves the diagnosis.

Gonococci are often not found in the discharge, this discharge being composed only of pus and epithelial cells.

In these cases an examination should always be made just after menstruation, as the mucosa at this time is more congested and the desquamation of the mucosa favors the throwing off of the deeper glandular secretions and the gonococci which have penetrated to these deeper structures.

The fact that the discharge after menstruation may be more infectious than at other times has undoubtedly given rise to the popular superstition that gonorrhea may be contracted from intercourse during the menstrual period.

Symptoms.—The usual symptom is a discharge. This may be very slight and be practically the only symptom, or painful urination may be found if urethritis is present also. There may be disturbances of menstruation if the endometrium is involved. Again, sterility may be the only complaint.

Examination usually shows a coexisting urethritis with involvement

of Skene's glands and the maculæ gonorrhoicæ. However, occasionally these are all absent and the one pathological condition found is around the cervix. Here the mucosa may be somewhat reddened and a discharge varying in type be found. It may be thin and watery or thick and purulent—yellowish or green in color. There may be slight eversion of the cervical mucosa membrane through the external os, and erosions which bleed more or less easily may be found on the cervical or posterior vaginal mucosa. The cervix may appear swollen and boggy and tiny varicose vessels may be seen around the os.

Diagnosis.—If a coexisting urethritis be found and erosions are present on the cervix, even if the gonococcus be absent, a diagnosis can be made with reasonable certainty; on the other hand, if there is no involvement of the urethra or other parts and erosions are absent, and no gonococci are found in the discharge, gonorrhea should not be finally excluded, but the case kept under observation and treatment and repeated examinations of the discharge made, especially at the time of the menstrual congestion.

Treatment.—Local applications to the cervix are especially indicated. The cervix should be brought into view by means of a bivalve speculum and then carefully examined. If erosions are present they should be wiped off with sterile cotton and then touched up with silver nitrate (10 per cent), Churchill's tincture of iodin, or plain tincture of iodin. Care should be taken not to carry any instrument up through the internal os, as in this way the endometrium may be infected. It is often advantageous to immerse the entire cervix in a solution so as to reach all the parts involved.

The Ferguson speculum is useful for this and it should be inserted until the cervix is on view, the solution poured in, and the speculum partially withdrawn. By so doing the cervix is dipped into a pool of solution and allowed to remain there for a number of minutes (five to ten minutes), and then the speculum is pushed into the original depth and depressed, when the fluid is easily drained out.

Silver solutions most frequently used (silver nitrate 3 to 5 per cent, protargol 2 to 10 per cent, argyrol 10 to 25 per cent).

In some cases, where the tissue seems boggy and congested and the inflammatory condition is not so marked, instillation of zinc salts in the manner described above is useful.

After the cervix has been treated in one of the above-mentioned ways, a tampon of boroglycerin (10 per cent), or ichthyol and glycerin (10 per cent) may be used; or a dry tampon sprinkled with aristol, dermatol, or iodoform may be placed against the cervix.

In cases where the discharge from the cervix is very profuse it is better not to use tampons at first, as they may dam back the discharge against the cervix. In the presence of a vulvitis it may be

necessary to tampon, and if so special precautions should be taken (see p. 142).

In chronic cervicitis the above treatment should be given in the office, at first three times a week and gradually reducing the frequency of treatment as the symptoms improve.

Douches should be ordered as home treatment, at first once or twice a day and later two or three times a week. In some cases the treatment may be hastened by the home use of suppositories containing various medicaments, ichthyol, protargol, zinc, etc. These can be inserted by the patient every other night or less often. The solutions for douching should be mild antiseptics or astringents as used in the office.

Acute Vaginitis

The vagina in the adult is one of the most resistant parts of the genital tract, as it is covered with pavement epithelium; and further, through the trauma occasioned by intercourse and childbirth, it becomes to a certain degree toughened and not easily infected. But the vaginal membrane readily becomes involved in young girls, whose mucosa is delicate, or in newly married women, whose mucosa is not hardened by congestion and trauma.

When the gonorrheal infection is hyperacute the entire genital tract may be involved in one continuous infection, and in these cases the vagina is not exempt.

Acute vaginitis may be primary, but is usually secondary to a gonorrheal cervicitis or endometritis.

Symptoms.—The patient complains of burning and a sense of weight in the vagina, and as the vaginitis is usually accompanied by urethritis and cervicitis, the symptoms of these conditions are usually added. Examination with a speculum in the knee-chest position (observing the precautions, p. 133) shows the vaginal mucosa to be the seat of an acute inflammatory process. The entire vaginal wall may be intensely congested, hot, swollen, and bleeding readily, or it may be bathed in a copious purulent discharge. Erosions with bleeding edges may be found, usually in the posterior fornix or in other portions of the vagina. The gonococcus can, as a rule, be readily found in the discharge.

Diagnosis.—Acute, nongonorrheal traumatic vaginitis is encountered in the newly married and among those who use strong medicated douches as a precautionary measure. These forms of vaginitis, puzzling at first, can usually be very easily differentiated by the absence of gonococci in the discharge and the almost immediate response to treatment when the cause is removed.

Other forms of vaginitis (due to the exanthemata, cervical car-

cinoma, or simple cervicitis) can be eliminated by the history and findings in each case and the absence of gonococci.

Treatment.—Rest in bed and frequent douches of mild antiseptic solutions should be ordered. In the most acute stages, when the pain is severe, boracic-acid douches, at a temperature of 100 to 110° F., under mild pressure, are probably the most beneficial and soothing. These should be given frequently, every two or three hours, if the discharge is profuse, and the utmost care should be taken in regard to asepsis.

If, at the time of the examination, the lower portion of the vagina is found to be the part especially involved, care should be taken to insert the douche tip but 1 to 2 inches into the vagina and flush out only the lower portion.

After the early acute stage is over, lysol or bichlorid of mercury (1 : 5,000 to 10,000) can be substituted, and gradually a daily or twice daily instillation of protargol (4 to 10 per cent) or argyrol (25 per cent) can be made with a glass syringe, the douche preceding this treatment.

Douches should be given sufficiently often to keep the vaginal outlet quite clean and thus preventing a secondary vulvitis. Between treatments absorbent vulva pads should be worn and these changed often enough to insure perfect cleanliness.

Chronic Vaginitis

Usually a history of a previous gonorrheal infection is obtained. Primary chronic gonorrheal vaginitis is rare, for the vagina, on account of its resistance, is about the last structure in the female pelvic organs to become involved, and when it does become the seat of a chronic gonorrhea, usually a profound gonorrheal infection has occurred elsewhere.

In chronic vaginitis certain areas of erosion of the mucous membrane are usually present.

Gonococci may have entirely disappeared from the vaginal discharge, which may consist of pus and epithelial cells alone.

Symptoms.—The only symptom complained of may be a slight leucorrhea, or the patient may have more or less pain in the vagina when walking or moving about. On examination with a speculum in the knee-chest position, the vaginal mucosa may be found covered with a purulent or muco-purulent discharge. Localized areas of erosion are usually present, and their presence keeps up the leucorrhea in part.

Diagnosis must be made from the other forms of vaginitis mentioned under acute vaginitis. It may be somewhat difficult in certain cases to make the diagnosis, as the gonococci have often entirely disappeared. By taking a very careful history and examining for other evidences of gonorrheal involvement, a fairly accurate clinical diagnosis

can be made. Oftentimes, by keeping the patient under observation, the symptoms change sufficiently to verify the diagnosis.

Treatment.—The treatment is in the main the same as for acute vaginitis (which see); in these chronic cases, however, the process is often very resistant to treatment. The erosions should be touched up with silver nitrate 10 per cent, or, in some cases, the silver stick or pure carbolic acid, followed by alcohol. Tamponage with boroglycerin or ichthyol and glycerin is often of great assistance, as is also the use of medicated suppositories. In certain cases the use of brewers' yeast is helpful. Again, a change of treatment to dry tampons covered with aristol or iodoform may bring about the desired results.

Acute Vulvitis

In the adult gonorrheal vulvitis is found much less frequently than in the child or young woman. The squamous epithelium of the vulva is more resistant in the adult than the child and the trauma of childbirth and marital relations make it more so.

Symptoms.—However, an acute vulvitis may occur and give very distressing symptoms; the chief of these are intense burning pain, worse on urination, a sense of fullness and weight, and extreme discomfort in the sitting posture or on walking.

Examination of the vulva in these cases usually shows the entire vulva to be the seat of an acute inflammatory process. The labia may be much swollen and edematous, and their inner surfaces bathed in a copious purulent discharge. On separating the labia excoriations of the mucosa may be found and the intensely inflamed surface may bleed easily.

Further examination of the vagina and cervix should be made with the precautions stated above, for occasionally the vulvitis may be primary, though more usually a urethritis and cervicitis also exist.

Diagnosis.—There are several conditions from which gonorrheal vulvitis must be differentiated.

Simple vulvitis, due to lack of cleanliness; this is often found in obese women, especially in hot weather and where there is intertrigo. The absence of the gonococcus in the smear from such a case and its prompt reaction to treatment will easily differentiate this form.

Diabetes often gives rise to a violent vulvitis, due to the decomposition of the diabetic urine by the presence of the torula saccharomyces. The age of the patient and presence of sugar in the urine usually eliminates this form without difficulty.

Vulvitis due to a *vesico-vaginal fistula* can be differentiated by the history and the finding of the fistula.

Vulvitis due to a discharge pouring down from a nongonorrheal

cervicitis or vaginitis may also be very puzzling until the discharge is traced back to its origin and a bacterial examination made.

Vulvitis due to the excoriating effect of the discharge from a *carcinoma* of the cervix or vagina may also simulate acute gonorrhea in its intensity.

Vulvitis complicating any of the *exanthematous diseases* can be differentiated by the history.

Treatment.—Primary gonorrheal vulvitis should be treated by rest in bed and absolute cleanliness. In the acute stage the vulva should be irrigated every two or three hours (if the discharge forms rapidly) with a warm boracic-acid solution or a bichlorid of mercury (1:6,000) or lysol ($\frac{1}{2}$ to 1 per cent), the patient being in the dorsal position on a douche pan, and the nurse gently separating the labia so that the irrigation may reach the internal surfaces of the labia and the vaginal and urethral orifices. After the irrigation has been given, a pledget of sterile cotton covered with sterile vaselin should be placed lightly between the opposed infected surfaces to keep them apart. A protargol ointment (2 per cent) can also be used with benefit.

After one to two days the irrigations may be given less often and three times a day (after an irrigation) the vulva may be painted thoroughly with argyrol (25 per cent) or protargol (4 per cent).

If the vulvitis is secondary to urethritis, cervicitis, or vaginitis, the treatment must also include the special treatment of these parts. Oftentimes, when a vulvitis is secondary to a cervicitis, the cure of the vulvitis can be much hastened by sealing off the cervix from the vulva by a dry tampon of sterile cotton after the cervix has been duly treated. In these cases it is very important that the patient be kept under constant care, as these tampons must never be left in long enough to dam back the discharge against the cervix and thus delay its healing.

Chronic Vulvitis

In certain cases resistant to treatment, or in cases which have been neglected, a chronic vulvitis may be found.

Symptoms are discomfort on walking or sitting and more or less discharge on the vulva.

Examination may show certain areas of localized inflammation, especially around the glands of Bartholin, which glands may in turn be indurated or the seat of abscess.

Diagnosis.—See Acute Vulvitis.

Treatment.—If the vulvitis is primary the careful and persistent use of the silver salts will usually cure the condition. All erosions should be touched up with silver nitrate (10 per cent) and the remaining mucosa painted with protargol 4 per cent. After such treatment it may be well

to dry the vulva very carefully and to powder it with aristol or dermatol.

Oftentimes zinc sulphate ($\frac{1}{2}$ per cent) will accomplish more than the silver salts and should be used alternately if results from the former are not satisfactory.

Suppuration of Bartholin's glands may call for incision and drainage, but if possible it is best to dissect out the infected gland as a whole, swabbing out the cavity with bichlorid of mercury (1 : 1,000) and packing with gauze. This calls for a general anesthetic or complete local anesthesia.

COURSE AND PROGNOSIS OF SYSTEMIC GONORRHEAL INFECTION IN WOMEN

Acute gonorrhea is usually seen either in young girls or in the prostitute class, and is characterized by the usual features of an acute infectious disease. After an incubation of ten to fourteen days (which, however, in some cases is as rapid as twenty-four hours) the patient is seized with severe constitutional symptoms, as chill, high fever, and rapid pulse. The local symptoms are, as a rule, very acute and may rapidly invade the entire genital tract, giving rise to acute endometritis, salpingitis, and peritonitis. Metastatic processes are not uncommon in these cases, as involvement of the joints, endocardium, and even meninges.

The course of the acute infection is about six weeks, after which time the case, with careful treatment, may recover or pass into a subacute or chronic state. The majority of gonorrheal infections in women are, however, from the start subacute or chronic in type, and it is this larger and more usual class which is the more difficult of diagnosis and treatment. The onset may be so insidious as to deserve the title of "latent gonorrhea." These cases usually present a very typical picture if the physician is on the alert and is aware of this form.

Gonorrhea is essentially an infection which tends to remain chronic rather than to recover.

Exacerbation of symptoms after apparent cure are very frequent. These may be especially noted at the menstrual period. Again, in a case supposedly cured, an attack of grippe or any indisposition which affects the general health and brings it below par may start an acute exacerbation of symptoms.

The symptoms thus excited are usually those of urethritis, cystitis, or cervicitis. The further complications of endometritis and salpingitis are especially frequent in these chronic forms, but space will not permit the consideration of these more purely gynecologic conditions.

Joint involvement may occur with these exacerbations, and in cer-

tain cases, where the invasion has been extensive and the course protracted, the patient seems to lapse into an almost septic state. The picture of the chronic gonorrheic is pitiable indeed. There is usually loss of weight, more or less anemia, general lassitude, and mental depression. She is the victim of menstrual disorders, dysmenorrhea, menorrhagia, and a chronic leucorrhea. These cases should be given the benefit of the serum therapy (p. 103).

The *prognosis* of a given case depends on several factors, the most important being the virulence of the infecting gonococcus. The resistance of the tissues and the intelligence of the early treatment are also of importance.

An acute gonorrhea contracted from an acute gonorrhea is usually most resistant and chronic. But this also depends on whether the infection to be a high or low one. Intelligent treatment at the onset may affect the prognosis materially. Thus, if the woman be impressed with the importance of constant conscientious treatment much may be hoped for. In cases of married women it is not enough to treat the wife: the husband must be reached in some tactful manner and put under treatment and sexual intercourse prohibited during the course of the disease.

Cases of mixed infection where (at the time of infection) the gonococcus is in a very attenuated form and the pyogenic organisms active may give at the onset the clinical picture of a most virulent gonorrhea. These cases, however, offer a good prognosis and usually make a satisfactory recovery.

Two cases which have occurred in the experience of the writer illustrate the foregoing types.

Miss L——, age eighteen, came to my office complaining of a burning discharge and painful burning micturition. On examination the vulva was found to be the seat of an intense inflammation, the hymen ruptured, and a thin, greenish pus discharge pouring down from the vagina. On further questioning, the patient admitted that she had been betrayed by her lover. A smear showed abundant gonococci. She ran a very acute course with active urethritis, cystitis, and cervicitis. Fortunately, the infection was held at the cervix and the uterus and tubes not infected. The patient has been most faithful as to treatment. One year after the first visit she had an acute appendicitis and I advised operation. At the time of the operation, on examining the uterus, tubes, and ovaries, all appeared perfectly normal. This case is still under observation and has been most resistant to treatment. She has a chronic urethritis and cervicitis, which light up with any slight indisposition. Over a number of months the symptoms are gradually improving and treatment is still continued. As far as can be ascertained, no further indiscretions have occurred.

Mrs. W—— age twenty, married six weeks: History of difficult coitus, vaginal outlet being very small, and as a result considerable trauma. Patient complained of a profuse discharge and pain in right lower abdomen. Her general condition poor, she ran a slight temperature, was pale. Examination of abdomen showed acute tenderness over McBurney's point, vaginally a violent vulvitis with a greenish thin pus pouring down from the vagina. Smears and cultures were taken for further examination. The case clinically was a virulent gonorrhea. She was kept under observation for about twenty-four hours, during which time active douching was started; bimanual palpation failed to show any involvement of the right tube, though this could not be excluded in the presence of the vaginal discharge. Operation was advised, as the temperature and tenderness persisted. I removed an acute appendix and again found normal uterus, tubes, and ovaries. The wound was closed without drainage and healed by primary union. The vaginal condition was treated with protargol (4 per cent), and at the end of a week all active inflammation had subsided. Her recovery was uneventful. The smear and culture in this case showed a very attenuated gonococcus and staphylococci. The husband was approached and a history of a gonorrhea nine to ten years previous to marriage obtained, the husband considering himself quite well at the time of his marriage. He was referred to a genitourinary specialist, who reported that he had a urethral stricture and pus in his urine. The husband put himself under active treatment until his urine had cleared up. The wife made a complete recovery, and a careful examination a year later failed to disclose any trace of the inflammatory process.

CURABILITY OF GONORRHEA

Can gonorrhea be cured in women? It would seem that the concensus of opinion is that one can scarce be certain of a cure.

A certain percentage of cases of acute urethritis recover completely. When the cervix and endometrium are involved the question of a positive cure becomes more uncertain.

A large majority of these cases, after careful, persistent treatment, are apparently cured and are discharged as such. It is impossible to assure such a patient, however, that the process may not start up again at some time under various conditions.

Before discharging a woman as practically cured she should prove the following examination:

1. That the leucorrhea shall have ceased.
2. That a smear and culture taken from the cervical secretion shall show no gonococci.
3. That Skene's glands shall be free from purulent discharge.

4. That Bartholin's glands and ducts shall be free of pus.

These tests should be made on several occasions and near the time of the menstrual congestion. No douche should be taken before the examination and the patient advised to take highly seasoned food and stimulants, which may excite a latent process into activity.

PROPHYLAXIS

It would seem that a very great deal could be accomplished along prophylactic lines in handling this greatest of venereal scourges among women. The problems to be met readily fall into two classes:

I. Those for which the physician is solely responsible. Too much stress cannot be laid upon the importance of absolute asepsis in the treatment of gonorrheal cases. The physician should be scrupulously careful as to his hands, gloves, and instruments. All instruments should be boiled before and after use on a gonorrheal case. All secretions and dressings from a gonorrheal case should be properly gathered in some receptacle (a paper bag) and later burned. The utmost care should be taken in regard to the use of pessaries. No pessary which has been worn by a patient should be used by another patient. If in the adjustment of new pessaries several have been used in order to obtain a satisfactory fit, the other pessaries can be boiled (if the style permit) or thoroughly cleansed with soap and water, soaked in bichlorid (1:500) for an hour or more, and finally returned to the stock.

The lubricant used in vaginal examination may also be a source of danger—the old, uncleanly method of a stock jar of vaselin or soapsuds should be condemned and a collapsible tube or bottle used instead.

II. The second class of problems to be met are those in which the patient as well as the physician plays a part. The youth of both sexes should be instructed in the physiology of sex and the importance of personal chastity.

The growing girl and young woman should be informed of the danger of gonorrheal infection—that it may be contracted from dirty toilets, towels, douche tips, and enema outfits. Oftentimes the family physician can impart such information.

The infected woman, whether she be innocent or guilty, married or prostitute, should be warned as carefully as possible of the infectiousness of her condition. The physician who clumsily imparts such knowledge and breaks up a marriage relation is often more culpable than if he had left matters alone. All are agreed that where the harm has occurred, the added wrecking of the home is not likely to help matters.

GONORRHEA AND MARRIAGE

It is before marriage and with a knowledge of an existing infection in either the man or the woman that the physician should speak.

This question arises much more frequently on the part of the man contemplating matrimony than the woman. Statistics state that 80 to 90 per cent of men have or have had gonorrhea, and yet of these how large a percentage marry, do not infect their wives, and have healthy children! It would seem that the percentages of cures among men was relatively high and the sterility due to gonorrhea relatively low.

Among unmarried gonorrheic women the majority belong to the prostitute class, and this class is notoriously sterile. It is seldom, if ever, that the marriage consideration comes up with these women.

But the physician is occasionally asked to pass on the marriage eligibility of a woman who has had a gonorrhea. How shall he advise her? Ignoring the fact that public opinion says that this woman has not the same right to marriage as her gonorrheic brother, the physician must pass on each individual case as an entity.

If the woman can pass the requirements as stated on p. 145, the physician may assure her that she is reasonably sure of not being in an infectious state.

If she has previously had an endometritis or salpingitis, the liability of sterility on her part is very great and the physician should frankly lay this before her.

CHAPTER XIII

GONORRHEAL URETHRITIS IN THE MALE

Gonorrhea, or gonorrheal urethritis, is the most venereal of all venereal diseases, since it is the commonest malady acquired during the copulative act.

A most respectable antiquity is given to gonorrhea by the fifteenth chapter of Leviticus, although it is contended that the discharge known to the Jewish lawgiver was a simple urethritis, and that gonorrhea did not appear until later (according to Astruc in the year 1545–46).

ETIOLOGY

Gonorrheal urethritis is caused by implantation of the gonococcus upon the urethral mucous membrane. This implantation occurs almost exclusively in sexual contact. It is quite possible for the male to abstract outlying gonococci from the vulva of a timorous partner without effecting intromission (I have seen two instances of infection thus acquired). It is even possible to transmit gonococci to the urethra on the fingers. Less direct methods of contagion may be looked upon with suspicion. The mythical bathtub and the legendary privy are calculated to excite derision. However certain it be that vulvo-vaginitis commonly results from indirect contagion, and that infection of an adult from a drop of pus on the edge of the closet seat is perfectly possible, it is, nevertheless, singular that such a mode of infection is only alleged by persons who are interested in concealing a transgression. In one instance I believed the closet story until the patient developed syphilis as well as gonorrhea. Frequently enough our patient relates that his partner was " perfectly clean." Such " perfect cleanliness " is reducible to three heads, as follows:

Usually the woman is supposed to be exclusively attached to someone else, who marches about in apparent health. In this case all three of the parties are undoubtedly gonorrheal, the suppliant acutely, the woman perhaps unconsciously, the accredited proprietor probably chronically. This explanation is founded upon the assumption that a woman may have gonorrhea and yet think herself clean (a matter of common knowledge, sufficiently explained on p. 131), and that a man and woman,

both infected, may cohabit habitually without exciting symptoms of gonorrhea in either. The latter assumption I believe to be entirely true. I have, for example, at present two persons under my care, a woman (F——) and a man (M——) whose history may be summarized as follows:

Spring, 1908, F—— infected with gonorrhea. Prompt "cure." November, 1908, F—— leaves her paramour and attaches herself to M——. M—— promptly acquires gonorrhea. December, 1908, M—— consults me. The woman is "perfectly clean." She has acute gonorrheal arthritis. I find gonococci in M—— and in F——. They continue to cohabit frequently. February, 1909, gonococci can no longer be found either in M—— or F——. There have been no further symptoms of gonorrhea in either. Local treatment has been employed by both.

Sometimes exposure is denied on the score that the male has worn a condom. In such a case the gonococcus has been acquired during preliminary skirmishing.

The most difficult case to explain is that in which the woman has been examined and pronounced clean by a physician. If the male actually harbors the gonococcus and has cohabited only with one woman, sufficiently careful examination of that woman will reveal the gonococcus.

That a woman may pass through an attack of acute gonorrhea and remain infectious, while never suspecting that she is diseased, is abundantly proven. That a male or female gonorrheic may cohabit with but one partner for many months before transmitting the infection is equally true.

PATHOLOGY

Urethral gonorrhea begins as an acute inflammation at the meatus, whence it travels inward along the urethral mucous membrane. Unless repressed by local treatment, this inflammation invariably travels as far as the bulbous urethra and usually invades the posterior urethra as well.

Although gonorrheal inflammation is essentially the same in the anterior as in the posterior urethra, it is easier to describe these processes separately.

Cytology of Gonorrheal Pus

The cytology of gonorrheal pus has been studied by Joseph,[1] Wile,[2] Posner,[3] Neuberger,[4] and Taylor.[5]

[1] *Archiv f. Dermat. u. Syph.*, 1905, LXXVI, 65.
[2] *Am. Jour. Med. Sci.*, June, 1906.
[3] *Berl. klin. Wochenschr.*, November 7, 1906.
[4] *Virchow's Archiv*, 1907, CLXXXVII, No. 2.
[5] *Jour. Am. Med. Assoc.*, 1907, XLIX, 1830.

The results obtained are nil. The predominating cell is polymorphonuclear. The eosinophile is always encountered, but does not harbor gonococci and is not pathognomonic. As Taylor says: "All of this detailed study of cellular elements of gonorrheal discharge, interesting as it may be, has contributed very little to our understanding of the nature, prognosis, or treatment of urethritis."

Pathology of Acute Anterior Urethritis

Onset.—The most accurate data we possess in reference to the invasion of the urethral tissues by the gonococcus are those published by Finger, Gohn, and Schlagenhaufer.[1] These authors inoculated the urethræ of criminals condemned to death, and were able, by means of immediate postmortem examination, to investigate the various stages of invasion of the tissues by the specific microbe. Thirty-eight hours after inoculation the gonococci had only just begun to effect an entrance between the epithelial cells. The lacuna of Morgagni was crowded with the cocci, diapedesis had begun, and intracellular gonococci were found among the few leukocytes on the surface of the epithelium. At the end of three days the inflammatory process was well under way. The surface of the mucous membrane was covered with pus, the epithelium infiltrated by bacteria from one side and by leukocytes from the other. The inflammation showed four striking characteristics, viz.: 1. The pavement epithelium of the fossa navicularis, although swollen with leukocytes, resisted the invasion of the gonococci almost absolutely. 2. The cylindrical epithelium of the penile urethra was generally invaded. 3. This invasion was most marked about the crypts and glands, which were packed with pus and gonococci; and 4. The subepithelial connective tissue, though showing every evidence of inflammation, contained few gonococci, except in the neighborhood of the crypts and glands.

Height.—When the inflammation reaches its height the mucous membrane, from the tumefied meatus to the bulbous urethra, is intensely inflamed. Its surface is red and swollen, covered with pus and, in places, eroded or ulcerated. The epithelia and the subepithelial connective tissue are infiltrated by the warring gonococci and leukocytes.

The glands and crypts form the most important centers of inflammation. They are implicated in the general process; inflamed and distended with gonorrheal pus. The gland orifices become obstructed by the tumefaction of the mucous membrane and the glands thus form centers whence infiltration (and even suppuration) extend into the sur-

[1] *Arch. f. Dermat. u. Syph.*, 1894, XXVIII, 277.

rounding tissues. Since the glands are numerous and extend to and, in some instances, even into the corpus spongiosum, the submucous infiltration (or suppuration) arising from them is often widespread and intense at the height of an acute gonorrhea, and leave infiltrations that are the chief cause of chronic urethritis.

Were the urethra as glandless as the conjunctiva, urethral gonorrhea would show as little tendency to chronicity, complications, and systemic absorption as does conjunctival gonorrhea.

Pathology of Chronic Anterior Urethritis

As this acute inflammation subsides the tissues involved may return to a normal, or at least clinically normal, condition, or the urethritis becomes chronic. The transformation of an acute gonorrheal anterior urethritis into a chronic condition implies certain pathologic and bacteriologic changes, as follows:

1. The inflammatory periglandular exudate becomes organized into cicatricial tissue of greater or lesser density and extent, according to the greater or lesser intensity and distribution of the acute inflammation.

2. The inflammation within the glands and crypts persists as a chronic catarrh (glandular urethritis of Oberlaender), or the orifice of the gland is occluded and the inflamed gland becomes a purulent or colloidal cyst (dry urethritis of Oberlaender), or the glandular inflammation ceases either by cicatricial obliteration or by return to normal of the gland. All three varieties may be met with in a single case which is denominated by the urethroscopic method in accordance with its predominating features. The submucous glandular abscesses are minute and usually terminate by rupture within the urethra, exceptionally by invasion of the surrounding tissues and external rupture.

3. The surface of the mucous membrane is chronically inflamed. The inflammation may be localized over one or more small areas or may be general. The quality of the surface inflammation depends upon the degree of submucous sclerosis.

If the sclerosis is slight the surface is swollen, red, and eroded in spots, while here and there appear the inflamed orifices of glands and crypts. The urethroscope shows increased redness, diminution of the number of urethral striæ and folds, and red, suppurating duct orifices. This is the *urethritis mucosæ,* the *soft infiltration* of Oberlaender.

More marked sclerosis causes a relative anemia of the overlying mucous membrane (after the redness of acute inflammation has disappeared), which is therefore salmon colored or grayish, lighter in color than the adjacent healthy mucosa. There may be spots of opalescent

whiteness, where the chronically inflamed epithelium has been transformed from a columnar to a squamous type with tendency to leukoplakia; i. e., heaping up of this squamous epithelium into thick "callous" masses. Elsewhere there may be erosions, ulcerations, papillary outgrowths. The urethroscope shows a pale rigid mucosa with striæ and folds almost or quite obliterated. Here and there one sees a white patch of squamous epithelium, red-gland orifices, bleeding erosions, ulcers, or papillomata. This is the *hard infiltration* of Oberlaender.

Still more marked sclerosis causes urethral *stricture*. The processes mentioned in the preceding paragraph are intensified. The rigid urethral walls do not yield to admit urethral instruments. The caliber of the urethra is more or less diminished, perhaps almost completely occluded.

The marked scleroses of greater or less degree are classified by Oberlaender as hard infiltrations of the first, second, or third degree. Hard infiltrations of the first degree do not encroach upon the urethral caliber. Those of the second degree diminish the caliber of the urethra to such an extent that large instruments [1] can still be introduced, but only at the expense of more or less laceration of the epithelium.[2] Those of the third degree do not admit large instruments until after they have been dilated.

These more or less arbitrary subdivisions correspond to clinical types of urethritis. Yet it must not be forgotten that they are but degrees of the same process. Therefore, while the mildest form of chronic urethritis may exist alone, the more intense "hard" infiltrations are at first always accompanied by a more diffuse "soft" infiltration which may for a time conceal them.

The soft infiltration may heal spontaneously; the hard infiltration requires treatment by dilatation, and leaves a permanent scar in the walls of the canal.

4. The flora of the gonorrheal urethra undergoes a marked change as the inflammation becomes chronic (p. 156).

Pathology of Posterior Urethritis

The pathologic changes produced by gonorrhea in the posterior urethra are essentially the same as those produced in the anterior urethra. But certain anatomical differences vary the actual conditions. These are:

In the membranous urethra—

The relative rarity of glands.

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[1] Oberlaender makes a urethroscopic tube of No. 23 F. size the criterion.

[2] This is the "stricture of large caliber" of the elder Otis.

In the prostatic urethra—

The complexity of the glands immediately beneath the mucous membrane.

The verumontanum.

The great complexity of the internal sexual glands (prostate, vesicles) emptying into the posterior urethra.

In the trigone—

The rarity and simplicity of glands.

We must, therefore, describe gonorrhea of—

1. The Membranous Urethra.
2. The Prostatic Urethra and Verumontanum.
3. The Prostate.
4. The Seminal Vesicles.[1]
5. The Trigone.

The Membranous Urethra.—The glands of the membranous urethra are relatively few and simple. Hence, chronic gonorrhea of the membranous urethra is clinically mild and is overshadowed by the inflammation of other portions of the canals. Submucous infiltrates are usually slight. Stricture is excessively rare, chronic glandular catarrh quite mild.

The Prostatic Urethra.—The relatively large and complex glands in the mucous membrane of the posterior urethra (p. 280) and the sinus pocularis of the verumontanum form nests for possible abscess formation during acute gonorrhea of the posterior urethra, and even after the acute general inflammation has passed.

These abscesses are larger than those commonly formed in the glands of the anterior urethra. They excite fever and burst into the canal with a recognizable outpouring of pus.

Chronic posterior urethritis is produced by inflammation in these glands and also by the far more important complicating prostatitis.

The Prostate.—The prostate is implicated in almost every inflammation of the posterior urethra. Prostatitis is by far the most important complication of genital gonorrhea in the male. It is frequent, it is intractable, it is the source of many grave lesions within itself, and is probably the usual port of entry of systemic gonorrhea.

Whereas the glandular lesions of the anterior urethra are almost exclusively due to gonorrhea, the prostate may be, and often is, inflamed by other bacteria. And in the prostate, whatever the bacterial agent, the resultant inflammation is much the same, though gonorrheal infections are more severe than others.

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[1] Gonorrheal epididymitis, because it differs so widely both in its clinical aspect and in its treatment from gonorrheal urethritis, merits separate consideration in Chapter LVIII.

Three types of prostatitis are recognized: the catarrhal, the follicular, and the parenchymatous. The distinction is a clinical rather than a pathological one. In the prostate, as in the less complex glands of the anterior urethra, the inflammation is a suppuration within the gland associated with more or less surrounding infiltration, which infiltration may terminate in sclerosis or in suppuration.

Catarrhal Prostatitis.—The inflammation extends into the prostatic ducts, but spares or does not markedly involve the acini. The inflamed ducts are dilated, filled with pus and *débris*. The surrounding stroma is but little infiltrated. The examining finger detects no change in the gland, but can squeeze pus from it. The diagnosis is not made until the acute posterior urethritis has subsided, leaving the chronic catarrhal prostatic lesion.

Follicular Prostatitis.—The inflammation reaches the acini, which are distended with pus, while the surrounding stroma is infiltrated. In the acute stage the prostate is congested, tense, sensitive. As the inflammation becomes chronic the general congestion disappears, leaving the gland lumpy to the touch. The lumps are constituted by areas of diseased acini, suppurating, cystic, necrotic, or atrophic, in an indurated stroma.

Parenchymatous Prostatitis.—The follicular involvement is more intense, the interstitial inflammation more widespread and intense. *Abscess of the prostate* results. The suppuration occurs in small multiple foci, few or many, which usually resolve without rupture, less often coalesce and rupture into the urethra or form a large prostatic abscess, clinically recognizable.

Chronic Prostatitis.—Macroscopic Changes.—To the examining finger the chronically inflamed prostate may show no change. More commonly it is enlarged. This enlargement consists of a general bulging of one or both lateral lobes or the presence of masses of induration in or about the gland.

The general enlargement of a lobe may be tense and irreducible by pressure, or it may soon yield to massage, leaving in its place a sunken pit surrounded by a more or less clearly marked rim of induration. With this subsidence of a swollen lobe under massage there is an outpouring of purulent prostatic secretion from the meatus.

The indurations may be prostatic or periprostatic. They are irreducible by massage, but diminish in size or disappear after repeated massaging or even, in time, without massaging.

Microscopic Changes.—The periacinous infiltration is so invariably present that we may speak of it as the essential lesion of chronic prostatitis. Sometimes it is combined with more extensive interstitial and endoglandular processes, but not infrequently in extensive areas the periacinous lesions may be present alone.

The changes in the acini are manifold. In some instances the culs-de-sac are dilated; this dilatation . . . may be due to stricture or obstruction in the excretory ducts, but is probably more often the result of an accumulation of inflammatory products in the glandular sacs, the muscular tone of whose walls has been injured by the inflammatory process. Acini, however, the caliber of whose lumina is diminished, are almost as frequently seen as are dilated ones, and this is especially true where the prostatitis is of long standing and an extensive periacinous sclerosis has formed. At times the acini are mere vestiges or may even be entirely replaced by fibrous tissue in areas of considerable extent. The acini are often partially or entirely filled with proliferating and desquamated epithelium. (Young, Geraghty, and Stevens.)

These lesions are unevenly distributed about the gland. Areas, large or small, of normal gland are usually present, and in some instances the diseased area is confined to that part of the gland adjacent to the urethra.

The dilatation of the acini may be very considerable. This dilatation is the foundation for Ciechanowski's theory of the inflammatory origin of prostatic hypertrophy.

Changes in the Secretion.—The normal prostatic fluid is an opalescent fluid, alkaline to litmus (and acid to phenphthalin, whence the arguments as to its reaction). As obtained by massage, it usually contains gelatinous, transparent masses of vesicular secretion. The pure normal prostatic secretion is filled with minute lecithin bodies. It contains a moderate number of columnar and round epithelia (the nuclei of the latter almost fill the cell body), a very few leukocytes, a few corpora amylaciæ, and perhaps red blood cells from the trauma of massage.

The abnormal prostatic secretion is purulent. It is neither so homogeneous nor so opalescent as the normal secretion. When mingled with urine (passed after massage) it often looks granular and flaky to the experienced eye. There often settles at the bottom of the glass a deposit of crumblike purulent masses (shreds). The normal elements are in inverse proportion to the amount of pus. The reaction, like that of the normal secretion, is acid or alkaline according to the reagent employed. Bacteria are sometimes present in great numbers. In rare instances pus is only obtained after the second or third massage, the secretion expressed by the first manipulation being exclusively from the normal portions of the gland.

The diagnosis of pus in the prostatic secretion should *always* be confirmed by the microscope.

Seminal Vesiculitis.—The changes caused by gonorrhea of the seminal vesicle are similar to those in the prostate, with this exception—that the vesicle is a gland of so much larger caliber and with so much larger a duct that abscess in it is uncommon, and its parenchymatous changes, if unaccompanied by dilatation, are often clinically overlooked.

The vesicles may be dilated or may show larger or smaller masses of induration. The little masses of induration frequently found above the prostate are commonly attributed to the vesicle.

It must be remembered that inflammations of the ampulla of the vas cannot be clinically distinguished from those of the vesicle.

The normal vesicle is impalpable unless greatly distended with semen. The vesicle, like the prostate, may be inflamed, though apparently normal to rectal touch.

The secretion of the vesicle varies in consistency from thick gelatinous to sticky and ropy. The microscope shows mucoidal masses entangling spermatozoa, sympexia, and epithelial cells. The color is usually opalescent, but may be rusty, especially in older persons, from pigmentation of the contained epithelia. When spermatozoa are absent Boettcher's crystals are usually found. The vesicular secretion floats (in part) in water, whereas the prostatic secretion sinks.

The secretion of an inflamed vesicle contains pus and bacteria. Live spermatozoa are sometimes, though not often, found in purulent vesicular secretion.

BACTERIA OF CHRONIC URETHRITIS

The occurrence of mixed infection in chronic urethritis is due usually to the bacteria harbored by the normal urethra, rarely to contamination by instruments. Moreover, the bacterial findings are not quite the same in chronic anterior urethritis and in chronic prostatitis. Hence we must consider:

The bacteria of the healthy anterior urethra;
The bacteria of chronic anterior urethritis, and
The bacteria of chronic prostatitis.

Bacteria Found in the Healthy Anterior Urethra.[1]—Pfeiffer examined 24 urethræ, and found bacilli of the diphtheria type in 21, streptobacillus in 10, staphylococcus pyogenes aureus in 5, micrococcus candicans in 4, sarcina alba in 14. Petit and Wassermann found 5 kinds of cocci, 6 kinds of bacilli. Franz, in 56 urethræ, found the sarcina once, the bacillus coli once, pyogenic staphylococci 6 times, streptococci twice, and 7 other varieties of cocci and 4 varieties of diplococci.

These bacteria are usually found at or near the meatus. The deeper portion of the anterior urethra is often sterile.

Bacteria of Chronic Anterior Urethritis.—Of 154 cases [2] examined 20 were sterile, 10 showed gonococci alone, 10 gonococci mixed with other bacteria, 114 other bacteria without gonococci.

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[1] The data quoted in this and in the following section are from von Hoffmann, *Centralbl. f. Harn u. Sex. Org.*, 1904, xv, 569.

[2] Reported by Tano, Cohn, Owens and von Hoffmann.

Of von Hoffmann's cases, the gonococcus apart, 18 showed pseudodiphtheria bacillus, 12 streptobacillus urethræ, 2 bacillus subtilis, 3 sarcina alba, 1 proteus vulgaris, 1 bacillus coli, 1 Friendländer's bacillus. He also found 27 kinds of staphylococci, 3 other cocci, and 6 kinds of bacilli.

Bacteria of Chronic Prostatitis.—Young, Geraghty, and Stevens,[1] examined 19 cases (2 nongonorrheal) and obtained a growth on agar in only 8. The staphylococcus albus was identified thrice, the streptococcus pyogenes twice. The anterior urethra was copiously irrigated and the prostatic secretion obtained through a sterile urethroscopic tube. Control cultures were made from the bulbous urethra.

Notthaft, using less careful methods, examined 120 cases. He found the gonococcus alone in 5 cases, all within eighteen months of the time of infection; the gonococcus alone or with other bacteria in 60 per cent cases less than eighteen months old, in 18 per cent cases from eighteen to twenty-four months old, in 6 per cent cases from twenty-four to thirty-six months old. The gonococcus was not found after the third year. The gonococcus was found 47 times, other micrococci 119 times, bacilli 15 times, other bacteria 14 times.

Cohn, in 12 cases, found staphylococcus albus 11 times, streptococcus 3 times, bacillus coli once, other bacteria thrice; no gonococcus.

Summary.—Thus the gonococci that swarm in the discharges of acute gonorrhea are by no means always present in chronic gonorrheal urethritis and prostatitis. Notthaft[2] quotes in favor of his thesis that they disappear from the prostate always within three years, often within eighteen months, the names of Neisser, Finger, Frank, Wassidlo, Jadassohn, Goldberger, and others. The thesis may, I believe, be extended to include all the urethral glands. I have seen but one apparently authentic case in which gonococci persisted for three years in the urethral secretion; not more than three or four in which, in spite of vigorous treatment, they persisted for over two years. The rule is almost without exception that a chronic gonococcic urethritis ceases to show gonococci in its secretion within three to six months of the beginning of intelligent local treatment.

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[1] Johns Hopkins Hospital Reports, 1906, xiii, 276.

[2] *Archiv f. Derm. u. Syph.*, 1904.

CHAPTER XIV

SYMPTOMS, COURSE, AND COMPLICATIONS OF ACUTE URETHRAL GONORRHEA IN THE MALE

Since acute gonorrhea of the male urethra always begins with inflammation of the balanitic urethra,[1] continues by direct extension of the inflammation along the urethral mucous membrane, and may terminate before the inflammation reaches the posterior urethra, to be accurate we should speak of anterior urethritis alone as essential gonorrheal urethritis and class all other gonorrheal inflammations, including posterior urethritis, that follow gonorrhea of the anterior urethra as complications. But inasmuch as the average uncontrolled urethral gonorrhea invades the posterior urethra, the trigone, and the prostate, it is clinically convenient to group anterior urethritis, posterior urethritis, and prostatitis in the type description of the disease and to follow with a description of other inflammations as complications. Accordingly, we shall describe:

The Incubation.
Typical Acute Gonorrheal Urethritis.
Atypical Acute Gonorrheal Urethritis.
- Prolonged or Complicated Cases.
- Mild Cases.
- Severe Cases.
- Cases Modified by Treatment.

Complications of Acute Anterior Urethritis.
- Abscess of the Urethral Glands.
- Periurethritis and Periurethral Abscess.
- Inflammation of the Erectile Tissues.
- Balano-posthitis, lymphangitis, lymphadenitis.

Complications of Acute Posterior Urethritis.
- Prostatitis.
- Prostatic Abscess.
- Seminal Vesiculitis and Deferentitis.
- Epididymitis.
- Cystitis.
- Pyelonephritis.
- Peritonitis.

[1] Excepting cases of reinfection of the urethra from gonococci that have lain quiescent in the urethral glands, which cases are properly classed as relapses.

INCUBATION OF GONORRHEAL URETHRITIS

The incubation period of gonorrhea varies from one to fourteen days. The earlier authors recognized longer incubation periods. Yet I confess to some suspicion of inaccuracy in reference to those cases on the subjoined list that give a story of more than ten days' incubation. Experimental inoculation produces a discharge on the second, third, fourth, or fifth day; but it has been my experience that the shorter incubations are clinically due to the association of sexual strain or of simple urethritis with the gonococcus. Such a condition may be expected to occur most often in the damaged urethra of the *roué;* hence the relatively large number of short invasions among recurrences as compared with first attacks. An uncomplicated gonorrheal infection of the virgin urethra has an incubation period of from three to ten days.

Length of Incubation [1]

Day.	First Attack.	Recurrence.
1	0	2 cases.
2	2 cases.	12 "
3	2 "	15 "
4	3 "	13 "
5	11 "	10 "
6	6 "	4 "
7	4 "	10 "
8	1 case.	2 "
9	1 "	1 case.
10	1 "	4 cases.
11	1 "	1 case.
12	1 "	0
13	1 "	0
14	0	2 cases
Total	34	76

Average incubation of 34 primary attacks, 6 days.

Average incubation of 76 secondary attacks, 4.88 days.

Of the primary attacks, 20 per cent appeared before the fifth day; 61 per cent on the fifth, sixth, and seventh.

Of the secondary attacks, 55 per cent appeared before the fifth day; 31 per cent on the fifth, sixth, and seventh.

TYPICAL ACUTE GONORRHEAL URETHRITIS

Onset.—A tickling, teasing, itchy irritation is felt at the orifice of the urethra. The lips of the meatus are found adherent, or a bluish, sticky discharge is seen between them. A slight stinging is felt on urina-

[1] I have included in this list only those cases in which the incubation period was unmistakable and the disease absolutely characteristic—microscopically, clinically, or both.

tion. The lips of the meatus now swell slightly and redden. The quantity of discharge increases and it becomes opaline. The meatus feels hot and sore. The pain on urination increases.

Height.—In a period varying from a few hours to two or three days the inflammation reaches its height at the meatus and has invaded the greater part of the anterior urethra. The symptoms of anterior urethritis are swelling of the meatus, purulent discharge, painful urination, and painful erections.

The Swollen Meatus.—The lips of the meatus are red, swollen, everted, sometimes eroded. Their tumefaction is in many instances absolutely typical of gonorrhea. It begins with the disease and usually subsides during the second or third week, long before the subsidence of the inflammation of the deeper portion of the urethra.

The Discharge.—The drop of thick greenish-yellow pus constantly exuding from the swollen meatus forms the outward picture of acute gonorrhea. Blood may appear in the discharge from time to time. The pus ceases to be thick and creamy some time after the swelling of the meatus has subsided. It becomes less in quantity and more watery and opalescent in quality as the acute inflammation of the anterior urethra declines.

The Pain on Urination.—The urethral mucous membrane is swollen, sensitive, and eroded. Hence, the passage of urine is painful, the stream slow and obstructed. From time to time the erosions bleed and blood mingles with the pus in the urine.

The pain due to anterior urethritis reaches its height within ten to fourteen days and begins to subside between the fourteenth and the twenty-fifth day.

The Painful Erections.—The urethral inflammation encourages nocturnal erections. The inflamed membrane is relatively inelastic, hence these erections are exceedingly painful. The inflamed surface is often cracked and fissured so that it bleeds copiously. Since the corpora cavernosa retain their normal distensibility, the inelastic, inflamed urethra is pulled taut beneath them when the penis is erect, so that in severe cases the organ is bent downward, while the pain is excruciating. This phenomenon is called *chordee*.

Painful erections often continue for days after the surface of the anterior urethra has ceased to be sensitive to the passage of urine.

During the height of the inflammation the whole anterior urethra is more or less swollen and sensitive to touch.

Invasion of the Posterior Urethra and Prostate.—It is clinically impossible to distinguish acute posterior urethritis from acute prostatitis, and although in some instances the posterior urethra is involved and the prostate apparently spared, this cannot be determined until after the fact.

The frequency of posterior urethritis in acute gonorrhea is estimated variously. Van der Poel estimates it at 60 per cent, Wassidlo quotes various authors at from 86 per cent to 92 per cent. Prostatitis is estimated to complicate about 70 per cent to 80 per cent of acute posterior urethritis, though Columbini places it as low as 36 per cent.

The confusion in these figures is due to the various means of examination employed. Subjective symptoms of posterior urethritis are excited by fully 60 per cent of initial gonorrheas, by not more than 50 per cent of subsequent attacks, and by less than 10 per cent of office patients treated by repressive measures. On the other hand, if pus in the second flow of urine is taken as a criterion, the percentages run approximately 80 or more, 70 or more, 30 or more. Let us be satisfied to say that acute posterior urethritis is extremely common and usually associated with prostatitis.

Posterior urethritis usually appears between the fifth and the fifteenth day of acute gonorrhea.

Symptomless Cases.—The figures given in the preceding paragraph illustrate the frequency with which gonorrhea invades the posterior urethra without causing subjective symptoms.

The evidence of this invasion is pus in the second flow of urine or palpable enlargement of the prostate.

It is probable that in these symptomless cases the prostatic urethra is only mildly inflamed, the trigone spared altogether.

Symptoms of Acute Posterior Urethritis and Trigonitis (Cystitis).—The symptoms of acute gonorrheal posterior urethritis, trigonitis, or cystitis are all referable to the irritation at the bladder neck. This causes frequent and urgent urination, painful urination, and terminal hematuria.

Frequent and Urgent Urination.—So long as the pain of urination is due solely to anterior urethritis the patient urinates as rarely as possible. When it is due to posterior urethritis he *must* urinate frequently. As soon as a relatively small amount of urine has collected in the bladder an urgent call to urinate is felt; a call that will not be denied. If the victim does not quickly acquiesce he irrigates his trouser leg. The frequency of this urgent call may be so great that the patient dribbles away a few drops of purulent urine every ten or fifteen minutes night or day. A frequency of less than once an hour by day and once in two hours by night may be accounted mild.

Painful Urination.—The pain of posterior urethritis is more constant than that of anterior urethritis, and is usually referred to some point on the surface of the body, usually the perineum, the anterior urethra just back of the glans, or the epigastrium.

The pain at urination in posterior urethritis has several striking characteristics. It appears before urination, as we have just seen, in the form of urgency. During urination the posterior urethra can be

more exquisitely sensitive than the anterior urethra. But it is at the end of urination that the full force of this pain is felt. As the muscles of bladder and urethra contract to expel the last drops of urine the inflamed surface is violently wrenched. The resultant pain, like that of anal fissure, is a spasm or series of spasms that may last for many seconds after the bladder has emptied itself. In severe cases the patient may be said to pass from one terminal urinary spasm to another.

Terminal Hematuria.—The intensity of the inflammation, together with the incessant trauma of the frequent urination, often excite bleeding from the posterior urethra. This bleeding may be constant or intermittent. In either case the amount of blood lost is not great, and the three-glass test reveals terminal hematuria; i. e., whether the body of the urine be bloody or not, the last jet is almost pure blood. Terminal hematuria is caused by terminal spasm.

The Decline.—The inflammation subsides first where it first began, i. e., at the meatus. The meatal inflammation often disappears in the second or third week, while the inflammation is elsewhere at its height. In the rest of the anterior urethra the inflammation usually begins to decline in the third or fourth week, rarely later; the discharge becomes thinner and more watery, the erections become less painful. The pain, frequency, and bleeding that mark posterior urethritis begin to diminish at almost the same time.

In the fourth or fifth week the patient's symptoms are reduced to a semipurulent discharge, which grows less and less in quantity. From the sixth to the eighth week this discharge usually continues almost or quite exclusively as "a morning drop," a drop of pus appearing at the meatus only before the first morning urination; during the rest of the day the urethra is apparently clean. Now the patient fancies himself well. But examination of the urine still reveals pus; examination of this pus still reveals gonococci.

It is rare for the gonococci and pus to disappear within six weeks. It is common for them to persist eight to twelve weeks.

By common consent the gonorrheal urethritis of less than two months' duration is called acute, of more than three months' duration chronic. The division is purely arbitrary, but it voices the fact that acute gonorrhea is often cured in from eight to twelve weeks.

ATYPICAL ACUTE GONORRHEAL URETHRITIS

The good or evil fortune of the patient in his choice of a physician as well as in his reaction to the disease so influences the course of each individual case of gonorrhea that the attempt to separate "typical" from "atypical" cases, though justified by expediency, has no foundation in clinical fact. The above description of a "typical acute gon-

orrheal urethritis" describes many cases in general but none in particular. Every case is actually "atypical" to a greater or less degree.

Prolonged or Complicated Cases.—What proportion of gonorrheics become chronic I do not know. In the clinic most cases approach the three-months' limit and perhaps half surpass it. In private practice, by the aid of repressive measures, we get better results.

But practically every unrepressed case of gonorrhea is a "complicated" case. Some one of the complications mentioned below almost invariably arises unless repressive measures are employed.

Mild Cases.—The initial gonorrhea is quite invariably severe. Subsequent infections, especially if often repeated, may run a much milder course; so mild, indeed, that it might be quite impossible to determine when a given patient was last infected. The bearing of this fact upon the alleged persistence of gonococci in urethral pus for many years in exceptional instances is most important.

Reinfections may excite merely a slight muco-purulent discharge with the least possible subjective irritation. The acute attack may last but a week or so. Yet from such an infection gonococci may persist in the urethra quite as long as though the attack had been most severe. Moreover, the urethra thus inflamed may resent instrumental or other traumata, though the reaction to these is not so fierce as when the urethral inflammation is more intense.

Sharp, short reinfections of the anterior urethra, with copious creamy discharge, yet lasting but a few hours or a few days, are more often due to reinfection from the patient's own secretions (occasioned by instrumentation, sexual or alcoholic excess, spontaneous rupture of follicular abscess, etc.) than to fresh infection acquired from without. The striking feature of such reinfections is the contrast between the profuse, creamy, gonococcus-laden discharge of to-day and the entire absence of all symptoms to-morrow.

Severe Cases.—Urethral gonorrhea may be severe in its onset (prompt involvement of posterior urethra or epididymis, early appearance of complications, intensity of subjective symptoms), in its complications, or in the severity or duration of its acute symptoms.

Thus chordee, or the pain and frequency of posterior urethritis, may be almost or quite the first symptoms complained of; epididymitis, even, may apparently begin the attack. Yet, unless they be autoreinfections, it is not correct to classify such outbreaks as beginning in the posterior urethra or in the epididymis.

The prolongation of intense chordee or posterior urethritis through many weeks occurs just often enough to remind us of the total lawlessness of gonorrheal inflammations.

Cases Modified by Treatment.—The local treatment now almost universally employed throughout acute gonorrhea always materially

modifies the course of the disease. If successful it ameliorates all the symptoms and minimizes the danger of complications; if unsuccessful, it intensifies the urethral inflammation, excites complications, or encourages chronicity.

COMPLICATIONS OF ACUTE ANTERIOR URETHRITIS

Abscess of the Urethral Glands.—Minute abscesses due to obstruction of the ducts of suppurating glands doubtless occur and pass unnoticed amidst the intense symptoms of every acute urethral gonorrhea. Such abscesses occurring during the declining stage cause a characteristic brief explosion of acute symptoms. After a day or more of vague localized uneasiness or itching a sharp reinfection of the urethra occurs. The discharge becomes profuse and creamy; the meatus may even swell, but there is usually no pain. But no sooner has the patient decided that he must look forward to weeks more of suffering than the discharge abates almost as suddenly as it appeared.

This sudden abatement of discharge is doubtless due to local immunity persisting from the preceding acute urethritis. It is exceptional for this immunity to be so slight as to permit prolonged relapse.

Periurethritis and Periurethral Abscess.—Exceptionally abscess of a urethral gland instead of bursting within the urethra begins in the corpus spongiosum and extends outward. The resulting suppuration is usually circumscribed. Diffuse periurethral suppuration occurs rather as a complication of trauma or stricture (p. 262).

This circumscribed suppuration arises from the balanitic, the pendulous, or the bulboperineal portions of the anterior urethra.

Abscesses arising from the balanitic portion of the canal appear at one or both sides of the preputial frenum. They grow rapidly and, having opened or been incised, often leave permanent fistula requiring a special procedure for its cure.

Abscess of the pendulous urethra usually projects from the floor of the canal as a hard, rather insensitive nodule. In this situation the abscess often grows quite slowly and may resolve (I have never known one to break into the urethra). It may invade the skin and open directly opposite to its point of origin, but frequently it travels beneath the fascia for a considerable distance before discharging externally, unless its course is cut short by incision. The fistula heals spontaneously.

Abscess of the perineal urethra is usually spoken of as *abscess of Cowper's gland,* though it is impossible to say in what proportion of cases this gland is actually the one involved. The inflammatory mass often appears to one side of the median line and, as in the above instance, may travel to a distance beneath the deep fascia before breaking through this.

All of these processes seem to travel forward, so that, while abscess originating in the pendulous urethra never points in the perineum, perineal abscess may show itself prominently only about the pendulous urethra. The attachment of the deep fascia to the anterior layer of the triangular ligament prevents extension of suppuration backward. Perineal gonorrheal abscess does not seem ever to leave fistula.

Inflammation of the Erectile Tissues.—*Spongeitis and cavernitis* are extremely rare complications of gonorrhea, if we except that type of the former that manifests itself in chordee.

Thrombophlebitis of the erectile tissues or inflammation of the fibrous envelopes manifest themselves as sensitive indurations of the erectile bodies. Under appropriate treatment they usually resolve, but they may suppurate and require incision.

Balanoposthitis.—The gonorrheic with a long or tight foreskin usually develops balanoposthitis in spite of all his care. Yet the complication is rarely severe. It has no peculiar characteristics, is apparently due to mixed infection, and readily yields to the usual treatment (p. 684).

Lymphangitis and Lymphadenitis.—These complications are rare, inasmuch as they are due to extension of the gonorrhea beyond the urethra proper. They result usually from balanitis, less often from periurethritis, and, like the balanitis of gonorrhea, are not specific and are rarely severe (p. 687).

COMPLICATIONS OF ACUTE POSTERIOR URETHRITIS

Prostatitis.—Any inflammation of the prostate short of abscess adds scarcely any symptoms to those of the urethritis. Mild prostatitis, like mild posterior urethritis, may give no sign of its presence, while a more intense prostatitis, accompanying posterior urethritis, does not alter the clinical picture already described. The involvement of the prostate may or may not be distinguishable by rectal touch.

But if the prostate is so severely inflamed as to excite symptoms, they are those of beginning prostatic abscess.

Prostatic Abscess.—In drawing an arbitrary division between acute prostatitis and prostatic abscess, it is wiser to include with the latter all cases of acute prostatitis of sufficient severity to cause symptoms. This for two reasons: all such cases do represent retention of pus within the prostate ducts, and any one of them may progress to unmistakable abscess formation.

To attempt to draw the line between the prostate in which macroscopic suppuration (abscess) has already occurred and that in which it only threatens is impracticable.

Symptoms.—The symptoms of prostatic abscess follow one of three types, as follows:

The *local symptoms are accentuated.* To the pain and frequency of urination due to posterior urethritis is added a constant dull or throbbing ache inside the pelvis, which may or may not radiate to the urethra, the testicles, the thighs, the hypogastrium, or the loin. If the prostate is much enlarged defecation may be both painful and difficult.

Fever, often severe, and ushered in by a chill, is added to the afebrile urethral inflammation. But fever is no criterion of the extent or progress of the prostatic involvement. Absence of fever is often noted in extensive prostatic suppuration.[1]

Retention of urine is a marked feature in many cases. Partial retention escapes observation; but acute, complete retention, requiring relief by the catheter, may occur. I have relieved by operation gonorrheal abscess in both lobes of the prostate, the only symptom of which was acute retention of urine, preceded by no dysuria and accompanied by no fever.

Yet in some instances one sees dysuria, fever, and retention simultaneously.

Physical Signs.—The suppurating prostate is always enlarged, usually sensitive. The whole of one or both lobes is involved. The diagnosis should be made long before boggy softening or fluctuation shows that the whole of a lobe has been transformed into an abscess cavity.

Course.—The process usually terminates by resolution; by rupture into the urethra (common), into the rectum (rare), or by passing on to chronic prostatitis.

Dr. Samuel Alexander [2] has studied 68 cases of gonorrheal prostatic abscess. Of these 31 appeared during the first gonorrhea, 37 during relapses; 35 caused retention of urine; 22 had burst—into the perineum (16), the ischiorectal fossa (5), the rectum (1). The abscess was complicated by urethral stricture 9 times.

If the pus burrows forward into the perineum it may occasion considerable mischief, burrowing along toward the corpus cavernosum, or even laying it bare (Demarquay). It has been known to go through the obturator foramen (Tillaux), and even to follow the connective-tissue plane about the spermatic cord and to point in the inguinal canal, or to get into the space of Retzius, to appear at the umbilicus, to pass by the sciatic notch (Guyon), or to burst through the posterior vesico-rectal *cul-de-sac* into the peritoneal cavity, or even, circumventing the bladder, to mount in front of the abdomen in the sheath of the rectus up to the

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[1] Keyes, *New York Polyclinic Journal,* 1908, xii, Nos. 9 and 10.
[2] *Am. of Surg.,* 1909, xlix, 533, 563.

ribs (Desnos, referring to Curtis)—all very rare, but still possible culminations of periprostatic suppuration.

Seminal Vesiculitis.—Acute seminal vesiculitis, like acute prostatitis, usually gives no sign of its presence. If suppuration occurs in the vesicle the symptoms are those of prostatic suppuration, but a finger in the rectum discloses a tense, sausagelike tumor in the region of the inflamed vesicle. Actual abscess is extremely rare. It usually terminates in resolution, but may rupture into the ischiorectal fossa or into the rectum.

Vesiculitis does not occur without prostatitis. It is impossible to differentiate inflammation of the ampulla of the vas from vesiculitis.

Epididymitis.—See page 612.

Cystitis.—The familiar gonorrheal trigonitis already described implies some inflammation of the rest of the bladder, but this is not a clinical feature of gonorrhea.

Pyelonephritis.—This is an extremely rare complication of gonorrhea. It is best described in connection with other types of pyelonephritis.

Peritonitis.—Pelvic peritonitis is as rare a complication of gonorrhea in the male as it is common in the female. Battey [1] has collected 30 cases. Thomas [2] reports 2 more. The inflammation is due to vesiculitis or deferentitis. Its symptoms are intense pain in the inguinal region, spreading to the iliac fossa, fever, rapid pulse, vomiting, intestinal disturbance (constipation or diarrhea), and peritonitic facies. The duration is usually short, the prognosis good. Battey reports but four fatal cases.

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[1] *Thèse de Lyon*, 1901, *Brit. Med. Jour.*, April 5, 1902.

[2] *North Western Medicine*, February, 1907.

CHAPTER XV

CAUSE AND COMPLICATIONS OF CHRONIC URETHRAL GONORRHEA

Chronic gonorrhea is gonorrhea lasting more than three months. The term is arbitrary and by no means strictly accurate, for chronic gonorrhea may be interrupted by acute relapses of the disease without thereby ceasing to be chronic, and chronic gonorrhea may begin and end, from the clinical as well as from the pathological standpoint, within the two months usually allotted to acute gonorrhea.

CAUSE

Gonorrhea becomes chronic because the urethral lesions caused by the gonococcus persist. These lesions may harbor the gonococcus alone, or in connection with other bacteria, or simply other bacteria without the gonococcus. They may involve the anterior or the posterior urethra or both. Chronic gonorrhea is therefore to be subdivided either as gonococcic and postgonococcic or as chronic anterior urethritis and chronic posterior urethritis.

The clinical causes of chronic gonorrhea are not worth enumerating in detail. Any interference with the proper treatment of acute gonorrhea may permit it to become chronic; in some instances it becomes chronic in spite of the best treatment.

VARIETIES

Study of the flora of chronic gonorrhea (p. 156) shows the rapidly decreasing importance of the gonococcus and the rapidly increasing importance of mixed infection after the third month of the disease. No further subdivision is possible; apart from the gonococcus no bacterium has shown itself peculiarly virulent in the male urethra. Nongonococcic urethritis is usually postgonorrheal.

Gonococcic chronic urethritis is distinguished clinically by a tendency to be more severe, to relapse more viciously, to resent the trauma of instrumentation and alcohol more sharply than does nongonococcic urethritis. Yet these clinical distinctions are both vague and relative.

They have meaning only to the expert. A specific urethritis may be latent for months, a nonspecific one may be peculiarly virulent.

To distinguish the symptoms of chronic anterior urethritis from those of chronic posterior urethritis is a necessity, but clinically the two usually exist together, the one or the other predominating.

Symptoms of Chronic Anterior Urethritis

The one subjective symptom of chronic anterior urethritis is a *urethral discharge,* greater or less in quantity, purulent, semipurulent, or sticky and mucoidal in consistence. Sensations of itching or pain almost invariably arise from posterior urethritis and its complications, even when the sensation appears to be situated in the anterior urethra.

But, since this urethral discharge is but the evidence of an overflow of pus, the flow may be intermittent and months, or even years, may elapse while an anterior urethritis continues but gives no outward sign; the only evidence it gives being a little pus or a few shreds in the urine.

The *course* of a chronic anterior urethritis may be interrupted by outbreaks of acute infection, either a relapse or a new gonorrheal infection. Such outbreaks are usually much less severe than the initial attack.

The only *complication* of chronic anterior urethritis other than those mentioned in the last chapter is urethral stricture.

Follicular abscess or abscess of Cowper's glands may remain, with hard walls as chronic suppurating pouches for months or years, filling up and becoming prominent from time to time, and maintaining a moderate gleet, subject to exacerbations, but always palpable as small shot-like lumps along the urethra.

The *urinary signs* of chronic anterior urethritis are a major element in diagnosis (p. 188).

Symptoms of Chronic Posterior Urethritis

Chronic posterior urethritis and chronic prostatitis can rarely be distinguished from each other. Indeed, chronic posterior urethritis is clinically synonymous with chronic follicular prostatitis. On the other hand, chronic prostatitis may not be complicated by chronic urethritis.[1] Such was the case in 30 per cent of 280 cases studied by Young.

Hence it is preferable to consider chronic posterior urethritis under the title of chronic prostatitis.

Chronic Prostatitis.—The symptoms of chronic prostatitis are much the same whether caused by the gonococcus or not. If gonococcic,

[1] I. e., the prostate may contain pus but the urine be free from pus and shreds.

the inflammation is more likely, either spontaneously or as the result of massage or urethral instrumentation, to light up an acute urethritis, while nongonococcic (or postgonococcic) cases sometimes flare up in the shape of vesical bacteriuria.

Hence it is clinically preferable to group all cases of chronic prostatitis, whether gonorrhea or not, under one head.

Etiology.—In our series of 358 cases, no etiology was obtained in 53 cases (14.8 per cent); there was a history of gonorrheal urethritis in 262 (73.2 per cent); of masturbation in 27 (7.5 per cent); of prolonged sexual excitement (without coitus) in 4 cases and withdrawal in 3 cases (2 per cent); of descending infection in 3 (0.8 per cent); of traumatism (bicycling twice) in 3 (0.8 per cent); of instrumentation in 2 (0.6 per cent); of infectious diseases (grippe) in 1 case (0.3 per cent). When gonorrhea had existed, that was accepted as the cause of the prostatitis, although in some of these cases abnormal sexual practices may have played an important rôle. Young, Geraghty, and Stevens.)

The infection doubtless reaches the prostate from the blood stream (probably not from the rectum) in the nongonorrheal and noninstrumental cases.

Bacteriology and Pathology.—Cf. p. 154.

Symptoms.—The symptoms of chronic prostatitis are classed by Young as urinary, referred, and sexual.[1]

The urinary symptoms are:

Urethral discharge.
Disturbance of urination.
Mechanical obstruction to urination.

The referred symptoms are:

Reflex pains and abnormal sensations.

The sexual symptoms are:

Disturbance of the sexual function.
Spermatorrhea and prostatorrhea.

Urethral Discharge.—Urethral discharge is a symptom of anterior urethritis. Yet persistent urethral discharge is the symptom that usually brings the victim of chronic prostatitis to the physician. Moreover, such urethral discharge can be cured only by treatment of the prostate. In the average case, therefore, chronic prostatitis is accompanied not only by posterior urethritis, but by anterior urethritis as well.

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[1] In their study of chronic prostatitis, Young, Geraghty, and Stevens have attributed to this malady certain symptoms (e. g., renal colic and pain in the rectum) characteristic of vesiculitis. For this reason the detail of symptoms given by them has not been followed.

Disturbance of Urination.—Urination may be normal, frequent, painful (before or during the act), urgent, or difficult. The stream may be slow to start or slow to terminate. None of these symptoms are absolutely characteristic of prostatis, nor can one infer the pathological process present from a consideration of them.

Obstruction to Urination.—Obstruction to urination, though a rare result of chronic prostatitis, may, nevertheless, be the most important feature of a given case. The obstruction is due either to an enlargement of the median isthmus in the form of a bar or to cicatricial contraction of the vesico-urethral orifice, i. e., stricture (contracture) of the neck of the bladder. The symptoms are those of prostatism, occurring in a young person. The prostate is usually not enlarged, as felt from the rectum.

Reflex Pains and Abnormal Sensations.—The abnormal sensation excited by chronic prostatitis is usually a pain, less often an itching or burning sensation, or a sense of fullness. The pain may be constant or intermittent; it is rarely very severe. It may or may not be excited by a full bladder or by the passage of urine. The majority of patients with chronic prostatitis suffer little or no discomfort.

The abnormal sensation is always referred to some point on the surface of the body. The sensation may be felt at any point below the navel, even as far away as the foot. But the characteristic pains of prostatitis are pain in the back, in the perineum, above the pubes, along the urethra, in the groin or testis, along the course of the sciatic nerve. Certain of these pains merit a word of description.

Pain in the Back.—The pain is usually in the lower lumbar region, constant and aching in character, uninfluenced by urination. Pain over the kidneys is rare.

Pain in the Perineum.—The perineal pain is usually so mild as to be little more than a sensation. It may or may not be influenced by urination. It is often associated with a peculiar sense of fullness in the perineal body, or with a peculiar irritability in that region, excited by continued pressure against the perineum. The patient who suffers from this symptom cannot sit down for any length of time, though, as a rule, he prefers a hard seat to a soft one. He is debarred from the theater and the church, and on the railroad he either sits obliquely on one hip or paces the aisle.

Pain along the Urethra.—Two spots along the penile urethra are especially subject to referred prostatic sensations. These are (1) the terminal two centimeters (or, more accurately, the penultimate centimeter) and (2) the penoscrotal angle. Many patients are obsessed with the belief that all their trouble lies in one or other of these spots, whereas the sensation there is a characteristic sign of trouble in the deep urethra and prostate.

Neuralgia of the Testis and Cord.—Neuralgia of the testis and spermatic cord, whether dependent upon ungratified sexual excitement or not, is very commonly due to spermatocystitis, rarely to prostatitis.

Sciatica.—Sciatica is a rare symptom of prostatitis, though it is not infrequently the first symptom of prostatic carcinoma.

Disturbance of the Sexual Function.—Premature and painful ejaculations, incomplete or painful erections, nocturnal emissions, and every other symptom of sexual neurasthenia occur in persons whose prostatic fluid contains more or less pus. Yet these symptoms are rare in patients with severe prostatitis. They are, if anything, more common in patients who have not had gonorrhea than in those who have. When they follow gonorrhea it is usually after a long interval. Hence, we may assume that in many instances the prostatitis and the sexual debility are due to a common cause, and that gonorrhea has usually but a very indirect bearing on the sexual weakness.

Prostatorrhea and Spermatorrhea.—Even more than the functional disturbance noted in the preceding paragraphs, prostatorrhea and urethrorrhea are functional sexual disturbances only accidentally postgonorrheal (cf. p. 181).

Symptoms of Chronic Vesiculitis.—Chronic inflammation of the seminal vesicle is always associated with chronic prostatitis. In the clinical picture either inflammation may predominate or one may doubt which is chiefly at fault.

The symptoms of chronic vesiculitis are almost precisely those of chronic urethritis. To enumerate these in detail would be vain repetition. Yet it is to be noted that sexual derangement is peculiarly attached to vesiculitis rather than to prostatitis, and certain types of referred pain are distinctly suggestive of vesiculitis.

Such are:

Renal colic, and

Pain in the rectum.

Renal Colic.—Renal colic may be caused by vesiculitis but not, as Young affirms, by prostatitis. I have seen several instances of this condition typical in every respect of a renal colic due to stone and requiring morphin for their relief. Yet in each instance the vesicle was manifestly diseased, pressure upon it elicited the pain, and treatment of it relieved the symptoms.

Rectal Pain.—A much more common and equally characteristic symptom of vesiculitis is pain in the rectum. It is apparently situated in the region of the vesicle, high up in the rectum. It is usually intermittent, excited by defecation, erection, or ejaculation, or it occurs spontaneously. The spontaneous pain occurs at night quite independently of any sexual irritation. It is griping in character, lasts only

a few minutes, occurs at irregular intervals, and has been appropriately termed *vesicular colic.*

Clinical Varieties of Chronic Urethritis

The preceding array of symptoms fails to give a picture of chronic gonorrhea. To obtain this we must sum up the clinical types of the disease in a few brief paragraphs.

All cases of chronic urethritis may be classed as follows:

1. Mild cases.
2. Intractable cases.
3. Relapsing cases.
4. Irritable cases.
5. Neurotic cases.

1. **Mild Cases.**
2. **Intractable Cases.** —Although most chronic inflammations of the urethra are mild in their symptoms, few of them are mild in responding promptly to treatment.

A slight discharge is all that marks the usual case. Yet this discharge may be utterly intractable. Rapidly curable cases are usually those in which the prostate is neither markedly inflamed nor hypertrophied, the inflammation postgonococcic, the patient tractable and in good surroundings and health. Conversely, any complication, especially severe prostatitis, the presence of gonococci, or bad general conditions are inimical to a cure.

3. **Relapsing Cases.**—Every case of chronic urethritis has some tendency to relapse after a cure has apparently been effected. But certain urethræ show a tendency in this respect little less than maddening. Perhaps the patient has been carried successfully through an acute gonorrhea by repressive treatment when an unexpected outbreak of the disease disappoints surgeon and patient alike. Or a chronic case may have gradually yielded to methodical treatment only to burst out afresh at the slightest provocation. Those cases that relapse year after year are often more annoying to the physician than to the patient. It is especially provoking when a patient leaves town with all the evidences of a cure to have him wire from the first station he stops at that his discharge is in full blast. To avoid this mishap it is absolutely essential to know, before pronouncing a patient cured, that his urethra and prostate no longer harbor gonococci. This fact ascertained, we may at least assure him against severe or infectious relapses.

A peculiar feature of gonococcic relapse is that it may act quite like a new infection. The inflammation spreads throughout the urethra in a few hours, due to a reinfection by the gonococci that had seemingly lost their virulence.

The cause of relapse may be a collection of pus in some gland or follicle, urethral or prostatic, or a local irritation due to alcohol, to sexual excess, to a cold in the head, or to excess in the local treatment. But the great predisposing cause is the catarrhal habit, whether natural to the patient or induced by overmuch work or dissipation. Without this any exciting cause may light up a relapse; but with it relapses occur and recur on the slightest provocation or on no provocation whatever, defying local treatment and demanding hygiene and tonics to effect a cure.

4. **Irritable Cases.**—Some urethræ are so sensitive that local treatment is next to impossible, whether because of the pain and spasm it evokes, or because an outburst of acute inflammation in the urethra, the prostate, the vesicle, or the epididymis follows every attempt at local treatment and every indiscretion on the part of the patient. This local irritability, while in a sense peculiar to the individual, is usually the result of habitual disregard of the rules of prudence. The patient is either a hard drinker, or addicted to sexual excess, or overworked and overworried, or—and this alternative is, unfortunately, not a rare one—he has been irritated by local treatment. An appreciation of this fact will help to direct the treatment of such cases.

5. **Neurotic Cases.**—The neuroses of the prostate are not habitually due to antecedent gonorrhea of that organ, and it is only exceptionally that one encounters evidence of neurosis while the inflammation still continues. The neurotic taint adds many and various symptoms to those of the inflammation, and protracts the patient's miseries even after his prostate has apparently returned to its normal state.

CHAPTER XVI

NONGONORRHEAL URETHRITIS

Nongonorrheal urethritis as distinguished from postgonorrheal urethritis may be classified as follows:

Tubercular Urethritis (p. 475).
Traumatic Urethritis.
Neoplastic Urethritis.
Syphilitic Urethritis.
Herpetic or Eruptive Urethritis.
Nonspecific or "Simple" Urethritis.
Urethrorrhea.
Prostatorrhea.
Spermatorrhea.

TRAUMATIC URETHRITIS

This is an inflamed condition of the urethral mucous membrane following injury, chemical or mechanical. It ranges through various degrees of intensity according to the severity and continuance of the provoking causes.

These causes are *wounds of the urethra* by instruments, more especially crushing or bruising injuries. Bending the penis when erect, as in tempestuous and badly directed coitus, may be followed by mild urethritis (sometimes ushered in by hemorrhage and followed by traumatic stricture).

A foreign body in the urethra, such as retained stone, may give rise to a mild discharge. Hallé and Wassermann have attempted to explain urethritis following moderate and aseptic traumatism on the ground that minor organisms existing normally in the urethra become capable of exciting suppuration when the soil is prepared for them by the concomitant action of trauma.

Rough catheterism, à fortiori if the instrument be dirty, may produce urethritis, and the suppuration habitually attending instruments left *à demeure* in the urethra is too well known to require more than a statement of the fact.

Caustic injections of any kind act as traumatic causes of urethritis.

Some urethras are very sensitive to the action of solutions of corrosive sublimate and carbolic acid, and much more so to the minutest dilutions of formalin, all of which substances, used as sterilizers of instruments, sometimes provoke the very mischief they would avoid.

NEOPLASTIC URETHRITIS

Papillomatous Urethritis.—An admirable study of this condition has been made by Oberlaender.[1] He does not believe that pointed warts under the prepuce or in the urethra are due to gonorrheal infection, yet he does consider them contagious. The urethral discharge in papillomatous urethritis is light in quality, and chronic from the first. Individual peculiarity Oberlaender believes to play an important rôle.

The papillomata are exactly like subpreputial warts, varying greatly in size. Oberlaender considers that papillomatous urethritis is only a more pronounced stage of the hypertrophic urethritis that sometimes follows gonorrhea. In this I differ with him, having often seen urethral warts, either a few near the meatus or many sprinkled along deeper in the canal, while the general mucous membrane was soft and pliable, and in no sense the seat of hypertrophic urethritis.

The malady may last indefinitely, individual warts disappearing to be replaced by others. Oberlaender cites a case of warts in the urethra of a patient who had had a discharge for twenty years.

Warts are not easily inspected through the urethroscope tube, as they bleed upon the slightest touch. When they are not visible at the meatus a diagnosis may be made by urethroscopy or by inserting a bulbous bougie of fair size and not bullet-shaped, but with shouldered acorn tip. This being deeply introduced, is pulled out against resisting pressure made by the thumb and finger upon and along the integument underlying the urethra just in front of the shoulder of the instrument. Upon this shoulder when withdrawn will be found typical fragments of warty material, and hemorrhage from the urethra will follow.

Other neoplasms of the urethra are less intimately connected with urethritis. They are described in Chapter LII.

SYPHILITIC URETHRITIS

Syphilitic chancre not infrequently involves one lip of the urinary meatus, more often perhaps the entire circumference, stiffening it, thickening the lips, and being more or less eroded and ulcerated down into the canal of the urethra. The discharge in these cases is very slight, but the sore lasts many weeks. Concomitant symptoms—inguinal

[1] "Sajous's Annual," 1888, ii, 212, from *Vierteljahresschrift f. Derm. u. Syph.*

adenopathy, finally an eruption—clinch the diagnosis. The urethral inflammation is only an epithenomenon.

A mistake, however, may arise when the chancre is situated at some distance within the urethra. The discharge in such event is slight, the incubation period between sexual contact and commencing discharge has usually been long (unless, unhappily, there be double infection), the gleet is more or less streaked with blood. But care will detect the enemy, and usually a hard lump of varying size, most often about that of a pea, may be plainly felt from the outside through the skin, and the endoscope easily clears up the diagnosis by disclosing a gray or livid, bleeding, exulcerated erosion. I have seen two of these through the endoscopic tube, one at a distance of about two inches from the meatus. How the virus reached this spot without infecting the outside is not clear, but the fact remains.

I have also distinctly noted an attack of gleet accompanying the development of a patch of tubercular syphilid upon the outside of the penis and disappearing under the use of mixed antisyphilitic medication by the mouth. Bassereau and Bumstead speak of cases of muco-purulent urethral flow coming on with the first appearance or with a relapse of secondary syphilitic eruptions, the cause of which was the development of syphilitic mucous patches upon the urethral mucous membrane. I have several times seen a patch of tubercular syphilid involve the urinary meatus and occasion a slight discharge. I have also seen gummatous ulceration of the balanitic urethra.

HERPETIC URETHRITIS

That an attack of ordinary vesicular herpes may occur within the urethra is well known, although not common. I have seen a group or two of vesicles outside and a mild urethral discharge, with smarting on urination, coinciding with the attack and disappearing spontaneously with it. Alternating attacks, one outside, the next inside, have also been observed. Eczematous subjects sometimes suffer from a mild discharge coincident with a new outcrop of cutaneous eruption upon or near the genitals, or with the sudden disappearance of the outside eruption.

NONSPECIFIC URETHRITIS

Nonspecific urethritis may be defined as an acute urethritis due neither to the gonococcus nor to the tubercle bacillus, and usually excited by no known cause other than sexual excitement or contact.

Under this caption we may also include the so-called *urethritis ab ingestis* and diathetic urethritis, neither of which seem to occur in virgin urethræ.

Urethritis ab Ingestis.—Certain substances taken into the stomach may occasionally produce a mild urethritis. Among these alcohol holds a high rank. Excessive potations, notably of beer or champagne, or prolonged excesses of alcohol in any form, will occasionally, without other cause, produce urethral discharge. As an adjuvant to sexual excess the influence of alcohol is paramount, more particularly if there be already a preëxisting patch of chronic inflammation anywhere along the urethra. Cantharides, arsenic, purgative mineral waters, iodid of potassium, turpentine, asparagus, have all been accused of lighting up mild urethral inflammation, but the rarity of such attacks makes their consideration trivial, and the whole subject may be dismissed with the words *Causa sublata, tollitur effectus.*

Diathetic Urethritis. — A gouty urethritis is accepted in England and a strumous urethritis has been mentioned; but as essential maladies both are a refinement of diagnosis. Surely the gouty old gentleman with densely acid urine is more liable to surface discharge because of his gout, and treatment of the latter may be essential to his recovery.

There are also well-observed instances of the appearance of a discharge from the urethra upon the subsidence of an arthritic eruption upon the skin, and Desnos alludes to the sudden appearance of a spontaneous urethral discharge during the course of the grip, believing it due to small prostatic abscesses bursting into the urethra. These diathetic agencies are then surely concomitant factors, if not essential causes, of primary urethral inflammation, yet they must be extremely rare.

Etiology of Simple Urethritis. — That the normal male urethra is immune to infection by any bacterium except the gonococcus is almost, but not quite, universally true. Yet most cases of so-called simple or nongonorrheal urethritis occur in urethræ damaged by gonorrhea or by sexual excesses. Indeed, when the simple urethritis occurs in a canal that has not previously harbored the gonococcus, its origin will usually be found, not at the meatus, but in the prostate and seminal vesicles—evidence of its sexual cause.

The bacteriology of nongonorrheal urethritis has not received the attention it merits. Von Hoffmann [1] shows that the bacteria found in the normal urethra are those usually found in simple urethritis. But such important questions as "Is the bacterium an etiological factor?" and "Is simple urethritis transmissible?" have not been adequately answered. It seems probable that nongonorrheal urethritis is sometimes transmissible. I have obtained a streptococcus from the urethra of a man with simple urethritis similar to that obtained from a vulvar

[1] *Centralbl. f. Harn u. Sex. Org.*, 1904, xv, 569.

abscess in his wife. A few similar cases have been reported, but they are most exceptional.

In the opinion of the laity nonspecific urethritis may be acquired from a nongonorrheal woman at or near the period of menstruation. This opinion has as little foundation as that which attributes infectiousness to nongonococcic leukorrhea. The male who acquires urethritis from a menstruating or leukorrheic woman with whom he has previously cohabited with impunity acquires gonorrhea.

Symptoms.—Simple urethritis is usually a very mild inflammation. There is little or no swelling of the meatus; the discharge is mild and often only muco-purulent; urination and erection are not painful. The incubation may be but a few hours or many days. The inflammation may last but a day or two or it may last many months.

These facts suggest that the condition of the patient's urethra and general health are of more importance than the bacteria.

Diagnosis.—Simple urethritis is distinguished from gonorrhea by the absence of gonococci from the discharge. The mildness of the attack may be suggestive, but is not absolute proof. Indeed, the onset may rarely be quite severe.

Since the disease is often due to prostatitis or stricture, immediate attention should be given to these conditions.

Treatment.—The treatment is that of declining or chronic urethritis. The organic silver salts are of no value in simple urethritis.

URETHRORRHEA

Urethrorrhea is a nonpurulent urethral discharge due to excessive secretion from the urethral glands. This discharge is mucilaginous in consistence, bluish-white in color. It sticks the lips of the meatus together. When caught upon the finger it strings out in a gummy way.

When abundant it stiffens, but does not stain the linen. The microscope shows it to be composed of single flat epithelial cells and clusters of the same, leucocytes, films of striated mucus, granular *débris*, no pus threads (unless there be also chronic urethritis), no prostatic bodies, no spermatozoa, no lecithin bodies, no Boettcher's crystals.[1]

The causes of this affection are prolonged, ungratified sexual desire, constant impurity of thought, a sort of mental masturbation through the imagination, often indulged in by weak-minded youths, as well as by old men who are regretfully conscious that they are getting beyond the potential stage of sexuality. Another cause is delayed organism during

[1] The fluid must be examined in substance. It cannot be recovered by the pipette from a specimen of urine since the latter totally dissolves it.

intercourse or withdrawal before emission, pernicious practices which occasion sexual strain. Masturbation if excessive, or too much natural sexual exercise under the stimulus of mental provocation—all these and the like, being a violence to the various urethral mucous glands and to the circulation of the urethra by prolonged, sustained, excessive nervous tension, lead to passive congestion and lack of tone in the circulation of the urethra and in its mucous glands and follicles, and thus occasion an excessive mucous secretion, together with more or less desquamation of pavement epithelium—and this is the whole malady.

The natural beading of the meatus during intense sexual excitement is physiological. It is equivalent to the watering of the mouth when one is hungry and smells appetizing food.

Whether it is fair also to denominate urethrorrhea that form of mucous oozing following chronic anterior urethritis in some cases, notably in the strumous, gouty, and debilitated, after the pus and shreds have disappeared, may be questioned; but it is much the same thing, being a mucoid oozing from congested surfaces which are not inflamed enough to yield pus.

Many a time a little, final mucoid drop of this sort is entertained for weeks or months by excess in local treatment due to unnecessary solicitude on the part of the patient and inordinate zeal on the part of the surgeon.

Treatment.—Urethrorrhea may sometimes be cured by local treatment, i. e., astringent injections; but usually it is only amenable to sexual hygiene.

But the true urethrorrhea, be it due to whatever cause among those enumerated, gets slowly better upon doing away with the continued action of that cause—be it lust, masturbation, excess, or what not which has occasioned it—and by insisting on urethral and general hygiene and such tonics as seem indicated, notably iron and strychnin. A minute dose of atropin, sufficient to dry the mouth slightly, assists. I think it also somewhat dries the urethral and prostatic secretion. Massage of the urethra by the passage of a large steel sound every three days through the anterior canal, or by the double-current metallic sound (Winternitz) with iced water, is sometimes helpful, with perhaps a light astringent injection. Strong injections irritate, and any injection may do as much harm as good, notably in those self-centered cases where morbid introspection is the salient feature of the malady. Here anything that keeps the patient's mind upon his genitals harms him, and any local treatment may be mischievous. A cold morning douche to the external genitals has a tonic effect. The patient's mind must be disabused of his morbid fancies. Horseback exercise is helpful, unless there be also chronic prostatitis, when it might do harm.

PROSTATORRHEA AND SPERMATORRHEA

Prostatorrhea is the nonsexual discharge of prostatic fluid from the meatus. Spermatorrhea is the discharge of semen. The fluid is discharged by the act of the pelvic muscles, usually during defecation, rarely during urination. It is impossible to distinguish prostatorrhea from spermatorrhea except by the aid of the microscope. The prostatic or seminal fluid discharged may be normal or purulent.

Etiology.—These conditions occur almost exclusively in young adults. They signify a relaxation of the prostatic or ejaculatory ducts due to sexual excesses or irregularities. They are not themselves inflammatory, though they may accompany inflammation.

The ducts may be atonic and relaxed and even catarrhal from the debility of age when there is enlarged prostate. Sometimes they become relaxed during the weakness following prolonged fever (typhoid). Sometimes they are relaxed by the congestion and strain of masturbation, more often by excessive and prolonged sexual excitement without relief, aided by erotic fancies and imaginings.

Symptoms.—The sensible man pays no attention to these discharges; the neurotic attributes to them any symptoms of sexual debility from which he may suffer.

There is no such disease as spermatorrhea. The alleged malady is a fetich created by Lallemand; a fetich to which its morbid worshipers, young and old, bow down throughout the community morning, noon, and night, offering to it the incense of their distorted erotic fancies.

I have known men having sexual intercourse nearly every night for years, and often more than once in a night, who had no single symptom of any sexual malady, and surely, if an excessive expenditure of seminal fluid were in itself capable of producing symptoms, these individuals should have shown some sign of these symptoms.

I have known every symptom attributed to spermatorrhea to occur in individuals who had no seminal loss whatsoever, voluntary or involuntary.

Finally, I have repeatedly found seminal elements constantly in the urine of vigorous men, ignorant of the fact, perfectly healthy in a sexual sense, and absolutely devoid of any of the alleged symptoms of the bugbear.

Therefore, while spermatorrhea as a symptom is a factor in diagnosis, yet I cannot consider it a malady, since the loss of semen *per se* does not occasion symptoms. Where it occurs essentially without the concomitance of a definite malady it does not cause symptoms, does not interfere with bodily or sexual health, does not threaten life or entail any consequences, and it may be and should be wholly disregarded. The

self-respecting genito-urinary surgeon must give the lie to quackery and disabuse the public of false ideas on this subject.

That the prostate and vesicles may be kept empty by massage is, of course, true. But such treatment, by concentrating the patient's attention upon his genitals, is only calculated to bring him new misery when, with the cessation of massage, the discharge returns.

The only cure is common sense, the only relief matrimony.

CHAPTER XVII

DIAGNOSIS OF GONORRHEAL URETHRITIS

There are two essential features in the diagnosis of urethral gonorrhea. We must distinguish both the presence or absence of the gonococcus and the distribution of the urethral lesion.

Diagnosis of the gonococcus:

Differentiation between simple urethritis and gonorrhea.
Discovery of the gonococcus in Chronic Urethritis.

Diagnosis of the seat of the lesion:

In Acute Urethritis.
In Chronic Urethritis.
Urethroscopic Diagnosis.

DIAGNOSIS OF THE GONOCOCCUS

Acute Simple Urethritis and Gonorrhea.—When a patient presents himself complaining of having contracted a gonorrhea, an inspection of his penis will often confirm or refute this opinion. If the lips of the meatus are red and swollen, exuding a creamy discharge, there can scarcely be a doubt of the specific nature of the infection. But *unless the urethral orifice is greatly swollen—unless there is ardor and chordee—an examination of the discharge is necessary to differentiate true gonorrhea from simple urethritis.* It may be that the gonorrheal inflammation is not yet well under way, or that there is chronic gonorrhea, of which this is an exacerbation, or, on the other hand, the whole matter may be a mere sexual strain. In either case the discharge way be slight or profuse, watery or creamy. The microscope and "the Gram" are required for an immediate decision, to save the surgeon from the possibility of an erroneous diagnosis and to afford the patient the advantages of immediate local treatment.

I fear not everyone will accept the statement that nongonorrheal urethritis can simulate the true specific inflammation; but I have seen cases that went through a very fierce attack and proved exceptionally unmanageable, although the patients denied any sexual act for many weeks before the beginning of their attacks, while repeated microscopical

examinations revealed no gonococcus in the discharge. In many other cases the acuteness of the onset gave every promise of a true gonorrhea, but the negative microscopic evidence was confirmed by the rapid subsidence of the inflammation under a course of treatment that never could have conquered the gonococcus. It is the relative frequency of such inflammations of the urethra that supports the quack and deludes the unwary.

Discovery of the Gonococcus in Chronic Urethritis.—"May I get married?" The frequency with which the sufferer from gonorrhea presents himself with this question on his lips is a sad commentary upon the levity of youth. Yet it is a question which the practitioner is frequently—nay, commonly—called upon to answer. And upon the correctness of that answer the happiness of a household often depends. An error on the side of overcaution—forbidding a man to marry when he has a perfect right to do so—is only less heinous from the patient's point of view than the permission to marry before the danger of infection has passed. On the one hand there is the prospect of moral despair for both parties, on the other the certainty of infection of the innocent with all its train of physical woes and the possible discovery of the guilty partner, with results that need not be dwelt upon.

And unhappily the question is not an easy one to answer. So difficult is it, indeed, that scarcely any two authorities agree as to the criteria upon which the answer shall be based. Against the genial vagueness of the light-hearted practitioner, himself a rounder and a *roué*, who proclaims that one is free from danger as soon as he is down to his customary morning drop, we may oppose the Spartan severity of those few authorities who assert that once a gonorrheic always a gonorrheic, once infected always infectious.

The broad-minded adviser will avoid either extreme. He will seek a middle course. Knowing full well that the majority of men who have had gonorrhea become and remain absolutely sound and clean, and recognizing, also, that while most of those who exhibit the traditional morning drop are undoubtedly infectious, there remains an important minority that cannot impart its disease, under whatever stress of sexual excitement. These are practical facts commonly encountered. We need not concern ourselves with those rare cases of alleged marital infection ten or twenty years after a cured gonorrhea. By their very nature such cases are open to a suspicion of that symptom common to all venereal disease, viz., lying; and against them I can advance the experience of thirty-five years, during which countless patients have been advised to marry by my father and his associates with no disastrous consequences, so far as I know; and all will recognize the probability that such an error would rebound forcibly enough upon its perpetrator. Such being

the case, I am willing to assert the possibility of determining in any given instance that infection may or may not occur.[1]

When does the gonorrheic patient cease to be in danger of infecting the woman with whom he cohabits? Not until the gonococci have been entirely eliminated from him. The gonococcus is the sole infectious agent. If it is present there is danger; if not there is none. But to find the gonococcus is no easy matter. Its presence may be *suspected* on account of the symptoms the patient presents—and this clinical evidence was all we had to go by until within a few years—or it may be *proved* by the evidence which bacteriology has at last evoked.

Clinical Evidence.—The clinical evidence of the presence or the absence of gonococci, which has been for so many centuries the surgeon's only criterion, is overshadowed nowadays by recent advances in bacteriology; to such an extent, indeed, that the signs and symptoms of the disease scarcely figure in the physician's estimation. Yet the bacteriologist is by no means infallible, and it is absolutely essential that the clinical evidence should accord before science is allowed to conclude that a patient is clean.

The notable clinical evidence of the presence of gonococci is pus, and in view of the prevalence of gonorrhea it is a general rule that *whenever there is pus anywhere in the genital or the urinary tract the presence of gonococci may be suspected, and conversely when the whole tract is proved free from pus the presence of gonococci may be denied.*[2]

Clinically speaking, a great many classes of cases may be ruled out at once. Thus, gonorrhea of the kidney is very rare and never occurs except in conjunction with gonorrhea of the lower urinary passages. Similarly the history of suppuration due to hypertrophied prostate, stone, tubercle, or tumor is usually such as to rule out gonorrhea. But the cases which come for a diagnosis on this point may be divided into three classes:

First, those who, having had gonorrhea, continue to have pus in the urine or are subject to relapses at every indiscretion, be it sexual or alcoholic.

Secondly, those who, having had gonorrhea, whether they allege a continuance of the discharge or not, are not subject to acute relapses, no matter how much sexual and alcoholic dissipation they indulge in.

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[1] While the *diagnosis* may thus always be definite, the *prognosis* must remain indefinite. I can tell a man that he is or is not now infectious, but if he is now infectious I cannot tell, with any certainty, when he will become clean. That is a matter of relative immunity, severity of lesion, faithfulness to treatment, and a thousand other details, differing for every case.

[2] With the single exception that the patient may have just been infected and may still be in the incubation period.

Thirdly, those who, after a gonorrhea, have no longer a discharge or any other symptom, and show perfectly sparkling urine.

Of the first class the majority are still infectious; of the second class the majority are no longer infectious, while all who continue in the third class for a month are certainly free from gonococci and from all danger. For these last, then, the clinical diagnosis suffices; for the others there is only a probability from which the experienced surgeon may often reach an assured conclusion one way or another, but a probability which always deserves to be confirmed by scientific tests.

The following points are also of assistance in the clinical diagnosis:

The presence of shreds in the urine, even when those shreds contain pus cells, is not probable evidence of the presence of gonococci unless free pus appears in the urine from time to time.

When the discharge and the centrifuged urinary sediment show a preponderance of epithelial over pus cells gonococci are very probably absent.

When the gonorrhea has lasted three years without reinfection gonococci have probably disappeared.

Finally, the clinical evidence is much fortified by excitation of the urethra. To this end the patient should be put through the following three tests at intervals of forty-eight hours: vigorous prostatic and vesicular massage, three glasses of beer, dilatation with a Kollmann dilator (or a full-sized sound). If these three tests fail to excite a discharge, the gonococci have almost certainly disappeared, even if the urine or expressed prostatic secretion continues to show pus.

Bacteriologic Evidence.—The practitioner will derive far more accurate results by leaning upon the clinical criteria of a cure than by depending upon his own unskilled interpretation of the microscopic findings. The specialist occasionally sees patients who have been inaccurately guaranteed free from gonorrhea, but far more often he sees those in whose urethral pus the honest practitioner or the commercial laboratory has discovered " a few extracellular gonococci," pure figments of the imagination. Gonococci are very hard to find in chronic urethritis. Practitioners with really adequate laboratory facilities may and do put great weight upon the bacteriologic diagnosis, but the country practitioner must depend upon the clinical tests.

I always apply the laboratory diagnosis, examining smears of discharge or centrifuged urinary sediment occasionally as the case progresses; then, when the gonococci seem finally to have disappeared, I obtain from a competent bacteriologist a test by stain and culture. If this shows no gonococci, the patient is tested by sound, beer, and massage, and the stain and culture test again applied.

The test by stain and culture must be applied to—

1. The discharge (if there be any).

2. The first urine passed (centrifuged).

3. The urine passed after massage of the prostate and vesicles (centrifuged) or the expressed secretion from these glands.

The specimens must be taken directly from the patient at the laboratory and examined immediately. The only precaution required to insure success are:

1. Sterilized tubes into which the urine is passed directly.

2. Immediate examination.

3. The application of the culture as well as of the staining tests.

4. A bacteriologist thoroughly conversant with the delicate technic of cultivating the gonococcus.

With these precautions accuracy is assured, as fully, at least, as by any other method, and with the concurrence of the clinical evidence it is absolute—given an expert clinician and an expert scientist.

DIAGNOSIS OF THE SEAT OF THE LESION

Diagnosis of the Distribution of Acute Urethritis

Acute nongonorrheal urethritis may originate either in the anterior or the posterior urethra. The diagnosis of its origin and extent is conducted precisely as is that of chronic urethritis.

Acute gonorrheal urethritis always begins in the anterior urethra. The pouting meatus and creamy discharge amply attest the presence of anterior urethritis. But to diagnose the presence of posterior urethritis is not always possible.

If both the first and second flows of urine are cloudy there is posterior urethritis.

If only the first flow is cloudy, there may be posterior urethritis. This is negligible for the time, but may cause trouble later by delaying the cure. In other words, the mere fact that throughout a carefully observed gonorrhea the second urine has always been clear does not absolutely eliminate posterior urethritis, and in the event of such a urethritis becoming chronic the posterior urethra must not be neglected.

Examination and massage of the prostate reveal lesions in that organ as in chronic urethritis; but in view of the freshness of the infection this examination should be conducted with the utmost gentleness.

Diagnosis of the Distribution of Chronic Urethritis

Since it is not my custom to use the urethroscope in the diagnosis of gonorrhea except in rebellious and protracted cases, I prefer to describe the routine method of examination that I follow at the patient's first visit, leaving the urethroscopic diagnosis for subsequent discussion.

Upon accurate diagnosis depends the patient's prospect of cure, and such diagnosis, even without urethroscopy, may require several examinations.

The patient presents himself with a history of chronic or relapsing urethral discharge, with shreds or pus in the urine, or with various sexual or painful symptoms.

The First Examination.—The examination for gonococci already described may take first or second place. The routine examination of the lesion is as following:

I. The meatus is examined for discharge (and a smear taken for microscopic examination) and inflammation, the urethra for nodules of periurethral infiltration, the testicles for evidence of epididymitis.

II. The patient then urinates in two glasses, as described in Chapter II.

III. The bladder is then filled through a catheter with a measured amount of 1:10,000 silver-nitrate solution. The presence of residual urine is noted.

IV. Prostate and vesicles are then massaged; any expressed secretion is caught upon a slide for examination.

V. The patient then empties the bladder into two glasses, if no secretion has been expressed by massage; otherwise into one. If residual urine is suspected, this is verified by measuring the amount passed.

From this examination we glean the following diagnostic points:

Anterior Urethritis.—Usually pus at meatus. Second flow of urine clear. No abnormality felt in prostate or vesicles. Normal secretion from these organs expressed or in silver-nitrate solution.

Posterior Urethritis.—No pus at meatus, unless there is anterior urethritis as well.[1] Second flow of urine may be clear or cloudy. Prostate and vesicles feel normal, but in their secretion (expressed or centrifuged from first glass of silver solution) there is pus.

Prostatitis.—Same as posterior urethritis except that indurations or abnormalities of contour are usually discerned in the prostate and the expressed secretion is purulent. There may be residual urine.

Vesiculitis.—Same as prostatitis, except that vesicles are distended or indurated. Vesiculitis without palpable change in the vesicle is always overlooked. Just as there is always prostatitis with vesiculitis, so there is often impalpable vesiculitis with prostatitis. The attempt to distinguish the expressed secretion of the two is likely to prove misleading, for though a large part of the vesicular secretion floats in urine, pus from the vesicle, like pus from the prostate, sinks.

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[1] Clinically there is almost always enough anterior urethritis to produce a morning drop.

Stricture.—Marked stricture obstructs or prevents the passage of the catheter. Slight stricture is not diagnosed until a subsequent examination. Cicatricial or prostatic obstruction at the neck of the bladder gives residual urine.

Cystitis.—It is probable that some inflammation of the bladder, or at least of the trigone, exists whenever the second flow of urine is purulent. But this cystitis is a negligible quantity that disappears long before the posterior urethritis is cured. Retention cystitis is, of course, important.

Pyelonephritis.—The diagnosis of gonorrheal pyelonephritis offers no peculiar difficulties (Cf. p. 376). The renal colic due to vesiculitis and the lumbar pain due to epididymitis are readily distinguished by the physical examination.

Object of this Method of Examination.—The object of this examination is to obtain the maximum of information about the patient while doing him the least possible harm. By it the precise lesion in the anterior urethra is not as accurately determined as though the bulbous bougie and urethroscope were used. But the risk of stirring up a urethra whose temper is not known, as well as the rarity of lesions requiring urethroscopic diagnosis, warrants deferring this more precise examination to a subsequent date (the following day, if the patient cannot be kept under observation, but preferably after a few days of treatment, unless the case is very chronic and has already been put through every sort of treatment by others).

The object of filling the bladder with silver nitrate is to provide an antiseptic to wash the urethra clean and a fluid from which the prostatic secretion may be readily centrifuged.

Secondary Examination.—In order to obtain precise information as to the condition of the anterior urethra one must use an exploring instrument. I no longer employ the blunt sound. The urethrometer is objectionable because of its rigidity and the difficulty of cleansing it. The urethroscope is unnecessary in the first examination. The bulbous bougie is the instrument of choice.

The largest bougie that will pass the meatus is lubricated and passed gently into the anterior urethra. As it advances the physician notes the position of every obstruction and even of every sensitive spot encountered. When it is just entering the bulbous portion of the canal it is withdrawn and the obstructions encountered verified as the instrument passes over them again on its way out. The bulb is then carefully examined and wiped off to discover traces of blood or pus upon it. It is then reintroduced rapidly to the bulbous urethra and, aided by firm counter-pressure on the perineum, insinuated into the membranous urethra.

By this examination we distinguish any stricture or erosion in the anterior urethra and locate it with considerable accuracy.

The great difficulty with the examination is that the bulb must be 24 F. to 26 F. in size, and the meatus is often too small to admit this. If this is the case, the meatus must be cut (p. 245).

A 26 F. bulb detects infiltrations that do not perceptibly encroach upon the caliber of the urethra. If the bulb detects nothing and anterior urethritis is nevertheless suspected, its presence is shown by irrigating the anterior urethra and examining the return for shreds and pus, or by urethroscopy.

Contra-indications to the Method.—Acute relapses or complications (e. g., in prostate or testis) prohibit instrumental examination until they shall have passed.

Inferences Drawn.—The diagnostic horizon is not limited by physical signs. We find by our examination that the patient has this, that, or the other lesion; indeed, we usually find that he has several lesions. But before the diagnosis is really complete we must know which is the predominant lesion and what part the patient's general condition plays.

The importance of the predominant lesion is this: Our examination reveals, let us say, prostatitis, anterior and posterior urethritis. Under these conditions we may feel confident that one of these lesions is more important than the others; is indeed the underlying lesion that keeps the others going. It may be that prostatic massage alone will cure the case promptly and permanently. Or maybe posterior permanganate irrigation is required. Or perhaps any attack of the posterior urethra does harm and the patient will recover on an anterior injection. Or dilatation may help. Or any local treatment may irritate.

These are not theoretic possibilities but practical facts. Diagnosis of the lesion is necessary, but an absolute therapeutic conclusion can rarely be drawn from that diagnosis. We must feel our way and try first one treatment and then another.

Concerning Shreds.—The purulent urine of acute urethritis does not contain shreds, but as the inflammation subsides and tends to become localized little scabs form upon the more inflamed areas and are washed away in the urine. These are called shreds (Tripperfaeden). To the general practitioner shreds simply mean that the general inflammation is subsiding or has subsided. When, day by day, the urine shows less pus and more shreds conditions are improving.

The trained eye recognizes a certain individuality in urethral shreds. There are five main varieties, any one of which may exist alone or all together. They are: small granular flakes, threads, the tadpole shred, angular pieces, cottony shreds, and for the most part may be safely interpreted as follows, whether occurring in company with free pus and bacteria in the urine or not.

The small granular flakes, a sort of urethral dust, are usually made up of pavement epithelium and more or less pus cells intermingled.

They generally come from the anterior urethra, are not very heavy, and settle slowly in the glass.

The threads look like bits of cotton thread. They are very white, of greatly varying length, dense in structure, and settle at once. They are composed of a dense aggregation of pus cells. They usually come from the anterior urethra.

The tadpole shred is a similar white thread with a globular head. It has the same general characteristics, and settles at once. It means that a small exulcerated or granular spot or an ulcerated follicle exists, yielding the pus that constitutes the head of the tadpole, the rest of the shred forming as usual along an inflamed line of urethra or in a fold of mucous membrane. Such shreds often come from the posterior urethra.

The angular broken pieces of irregular size (not threads) are usually an indication of chronic inflammation (often stricture). They settle quickly.

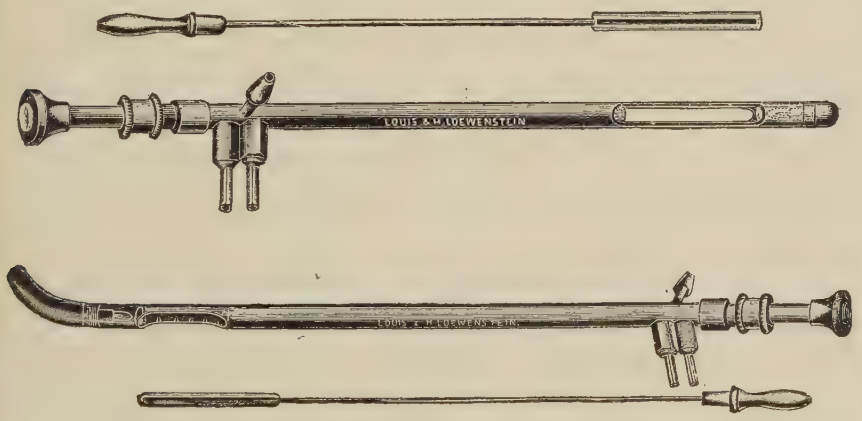

Fig. 44.—Goldschmidt Urethroscope.

The fleecy, cottony, filmy shred often seen single and alone in otherwise nearly or absolutely clear urine come from the prostatic sinus. This filmy mass floats a long time in the urine, and sometimes rises to the top instead of settling to the bottom, sometimes dissolving in the urine. Microscopically it is found to be thin mucus entangling in its meshes leukocytes, round cells, squamous epithelia, sometimes sympexions, and rarely a stray spermatozoön or a few crystals of oxalate of lime, with possibly some bacteria, but never gonococci.

Urethroscopic Diagnosis

The urethroscope is often applied to the diagnosis of lesions of the anterior urethra, rarely to those of the posterior urethra.

Great results are expected from the use of the Goldschmidt urethro-

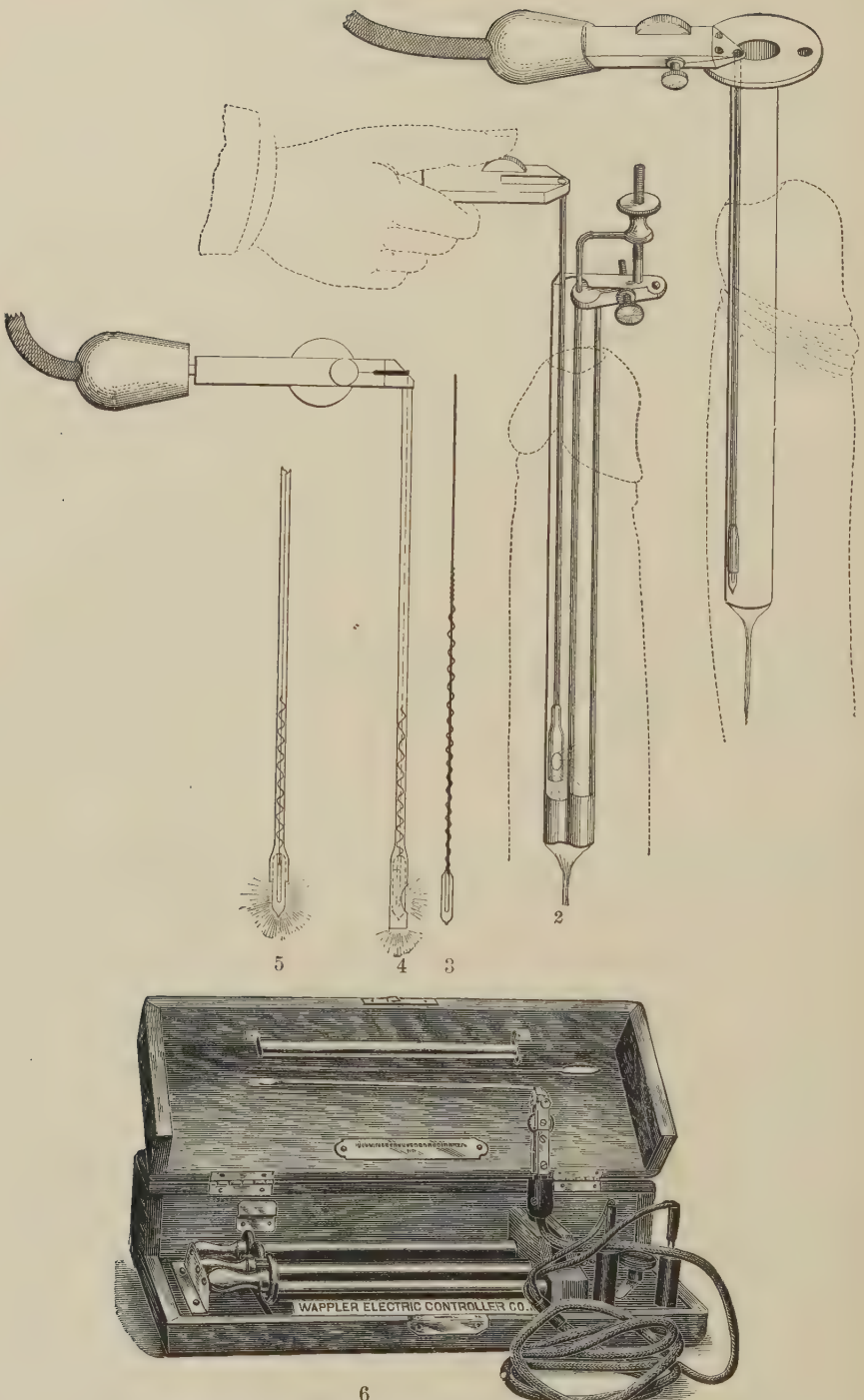

FIG. 45.—CHETWOOD URETHROSCOPE. 1, instrument in use with endoscopic tube; 2, same, with wire speculum in place of tube; 3, Koch cold lamp; 4, protected lamp used in wire speculum to avoid burning the urethra; 5, unprotected lamp; 6, apparatus complete, with battery; dimensions, 10 in. × 5½ in. × 2¼ in.

scope, but although a better view of the urethra may be obtained through this instrument (Fig. 44) than through the familiar model, no practical advantage has been proven for it as yet.

The familiar model consists of a tube 12 cm. long, size 24 to 28 F., fitted with an obturator. This is employed only for the anterior urethra. The Swinburne urethroscope is employed for the posterior urethra, of which it only demonstrates the floor.

Illumination may be obtained by reflected light from a head mirror, but special electric illumination is better. Some prefer an external source of illumination (urethroscopes of Leiter and Otis). Others internal illumination (using the Koch cold lamps) (urethroscopes of Chetwood (Fig. 45), Valentine, Pryor).

Urethroscopic Appearance of the Normal Urethra.—*The navicular urethra* is pale, glandless, rigid. It shows a vertical slit; no folds or striæ. Upon the roof is seen the opening of the lacuna magna.

The pendulous urethra shows a cone of mucous membrane varying in color from pale pink to salmon pink. The cone is made by the falling together of the urethral walls beyond the end of the urethroscope. In it are seen longitudinal folds, four to twelve in number, radiating from the center to the circumference of the field. Upon the mucous membrane between the folds are seen the longitudinal, deep-red striæ. Upon the urethral roof (and less frequently upon the floor), as the tube is slowly withdrawn, the crypts of Morgagni pop into view, deep-red indentations the size of a pinpoint, in the mucous membrane. The normal ducts of Littre's glands are invisible.

The bulb shows a somewhat different picture. The lumen of the urethra is a lateral slit or the whole field is occupied by the flat surface of the floor of the urethra. Upon this surface the ducts of Cowper's glands open. They are often overlaid by a V-shaped fold of mucous membrane (point inward).

The membranous urethra is deep red, bleeds easily, and shows nothing of importance.

The prostatic urethra is deep red and bleeds easily. Upon its floor is seen the elongated projection of the verumontanum. The mouths of the sinus pocularis, the ejaculatory ducts, and the prostatic ducts are not often seen.

The Inflamed Urethra.—*Anterior Urethra.*—When subacutely inflamed[1] the surface is red and velvety. The gloss and the brilliant red striæ are lost. The swelling of the mucous membrane reduces the number of longitudinal folds. Patulous crypt orifices are seen exuding pus.

Mild chronic anterior urethritis (soft infiltration) shows much the

[1] Acute urethritis absolutely contra-indicates urethroscopy.

same picture. The redness is not so marked, the luster of the surface may be increased, but the striæ are lost, the folds reduced, the crypts red, patulous, purulent, or cystic.

Severe chronic anterior urethritis (hard infiltration) in which the inflammatory exudate has been largely converted into scar tissue shows a gray, eroded, lusterless surface with no striæ, few or no folds. The ducts of Littre's glands may project as minute vivid red points in the midst of a mass of congestion (glandular type) or these red spots may be absent (dry type). Sclerotic white patches or stellate white scars may appear here and there.

Posterior Urethra.—The surface is red, swollen, eroded, and may show minute abscesses. Redness and tumefaction of the verumontanum is the most notable change. It may be so enlarged as to fill the urethroscopic field.

CHAPTER XVIII

METHODS AND DRUGS EMPLOYED FOR THE LOCAL TREATMENT OF URETHRITIS

Local treatment of the urethra is administered in the following ways:

Injection with small piston syringe.
Forced irrigation with piston syringe.
Forced irrigation with wall tank.
Catheter irrigation.
Instillation of fluids.
Instillation of ointments.
Urethroscopic applications.
Rectal treatment.
Rectal massage.
Rectal irrigation.

METHODS EMPLOYED

Preliminary.—The patient should empty his bladder, if he can, immediately before any treatment is applied to the urethra.

Injection

The instrument employed is a quarter-ounce glass or hard-rubber syringe. The tip may be of soft rubber and should be blunt, so as not to injure the urethral mucous membrane.

The syringe is filled and its nozzle applied *within* the lips of the meatus. To accomplish this these lips must be gently drawn apart, the nozzle inserted snugly between them, and the lips then carefully pressed against the syringe, while the injection is made by *slowly* depressing the piston.

The pressure upon the meatus should be lateral, not from above downward. If the fluid is to be retained more than a moment the syringe is withdrawn while the lateral pressure is continued, or the fluid may be retained by Chetwood's urethral clip.

Excepting in the prophylaxis of gonorrhea, there is never any reason

to prevent the solution from entering the bulbous urethra; no pressure should therefore be put upon the urethra at the penoscrotal angle. If gently and intelligently performed, the injection will never "light up" the posterior urethra or the epididymis.

In the first days of a gonorrhea injections may be repeated as often as every three hours, thereafter not oftener than three or four times a day, and in chronic gonorrhea not oftener than once or twice a day.

Some patients can voluntarily relax the external sphincter and permit the injection to flow into the posterior urethra. This may be encouraged by massaging the urethra with one hand while holding the meatus with the other. But this practice is not without danger and should be employed only in exceptional cases.

Forced Irrigation

The motive force is obtained either from a large (150 to 200 c.c.) piston syringe or from a wall tank so arranged that it can be lowered or raised at will. The nozzle I employ on the syringe is a soft-rubber tip removed from a glass urethral syringe. For the wall tank, the nozzle usually employed is some modification of the Janet's nozzle, shield, and cut-off. I employ the Chetwood scissors and two-way glass nozzle for irrigating the anterior urethra, the Swinburne cut-off and shield and the Janet (the so-called Valentine) nozzle for irrigating the posterior urethra. If the whole urethra is to be irrigated I use the latter apparatus.

The tank is more convenient than the syringe for anterior irrigation. The level of the fluid in the tank should stand one to two feet above the urethra. For posterior irrigation either tank or syringe may be employed. In order to force the sphincter the tank must be raised three to five feet above the urethra. I believe the sphincter can be forced more gently with the hand syringe [1] than with the tank. With it one appreciates and yields to the varying pressure of the sphincter, forcing the fluid vigorously only when this resistance is overcome. But, inasmuch as at least 300 c.c. should usually be employed for a posterior irrigation, two syringefuls are needed.

To irrigate the anterior urethra 1,000 c.c. is generally used. This is run in and out of the urethra by alternately approaching the nozzle and opening the cut-off and removing the nozzle while closing the cut-off. The force of the inflow is gauged by the patient's sensations, which should not be painful, and the sense of urethral distention imparted to the fingers holding the meatus. The shield catches the splashing outflow.

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[1] The Janet, Janet-Frank, and Janet-Hayden are the best.

Instead of this slopping way of irrigation I prefer to employ the Chetwood scissors shut-off and two-way nozzle.

The figures illustrate the mechanism. Hot water from a fountain syringe enters the smaller inlet tube, thence flows into an outside sealed chamber, and escapes through the small perforations near the end. The water flows back again through the central tube, which is larger than the

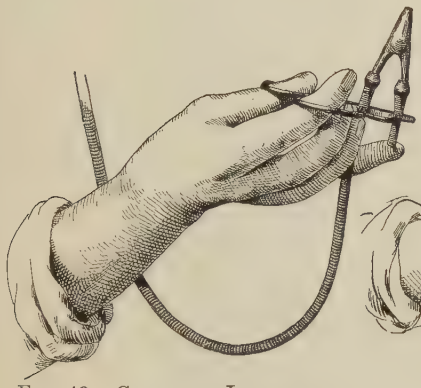

FIG. 46.—CHETWOOD IRRIGATION. Filling the nozzle.

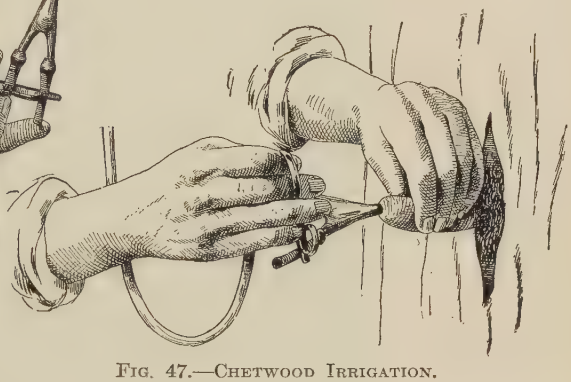

FIG. 47.—CHETWOOD IRRIGATION. Inserting the nozzle.

combined holes of exit in the external tube. In spite of this facility of exit the water does not flow out of the rectum so readily as it flows in, and every patient has to learn for himself how to manipulate the end of the tube in order to favor the outflow of the water, on pain of giving himself an enema—no very serious matter.

The nozzle and scissors are attached and the instrument filled in the manner shown in Fig. 46. The nozzle is then applied to the meatus (Fig. 47) and the scissors alternately opened and shut, permitting intermittent irrigation of the canal.

CATHETER IRRIGATION

The catheter is introduced as described in Chapter IV. If the anterior urethra is to be irrigated the catheter should be not larger than 15 F. and should be introduced (about 12 cm.) into the bulbous urethra.

If the posterior urethra is to be irrigated the catheter (16 to 18 F.) should be introduced until its eye enters the bladder and a few drops of water flow away. As soon as the bladder has thus been drained the catheter is withdrawn 1 to 2 cm. into the posterior urethra. The fluid is then introduced by tank or syringe. If the patient can empty his bladder the catheter is then withdrawn and the fluid urinated out. If there is retention the fluid must be withdrawn by pushing the catheter

back into the bladder. If the retention is slight either method may be followed.

Instillation

The Keyes or the Guyon instillator may be employed for fluids; only the former can be used with ointments. The object of instillation is to place upon a given portion of the urethra a few drops of a solution so concentrated that it could not be used over an extended area or in large quantity.

The instillator is introduced like a sound or a woven catheter. Inasmuch as the instillation is usually intended for the bulbous urethra or

Fig. 48.—Tip of Instillator in Bulbous Urethra.

the membranous urethra, one should have a clear idea of the precise position of the instrument as its tip enters the posterior urethra. The jump as it passes the external sphincter is often quite palpable; but in

case of doubt one may always feel confident that when the instrument has reached a point in the urethra where its shaft rests without pressure at any angle between the perpendicular and the patient's feet, its

Fig. 49.—Tip of Instillator in Posterior Urethra.

point is in the membranous urethra (Figs. 48, 49). Beyond this the instrument should not be introduced. The fluid injected will bathe the whole deep urethra.

In order to instill an ointment I employ an antitoxin syringe attached to the Keyes instillator. The syringe must be taken apart for filling. I see no peculiar virtue in any of the numerous ointment applicators that are devised from time to time.

Urethroscopic Applications

By means of the urethroscope one can apply strong solutions on swabs even more precisely than by the instillator. Some physicians, following the German teaching, employ this method almost exclusively in the treatment of chronic urethritis. I rarely employ it.

Rectal Medication

On account of its proximity to the posterior urethra, the rectum has always been a favored receptacle for drugs intended to benefit the urinary canal, especially when that channel was too acutely inflamed to permit local applications directly to it.

Opium and antipyrin to relieve pain, and ichthyol and iodoform to reduce inflammation, are the drugs in vogue. I have had no luck with any of them. In my hands opium has worked better when given by mouth or by hypodermic, and rectal irrigations of hot and cold water have proven much more efficacious than any chemical medication by this route, while massage, if permissible, is more efficacious still.

Massage.—The way to examine the prostate and seminal vesicles by rectal touch has been described in Chapter I. Massage of these organs, to be intelligent, requires familiarity with their normal contour.

Massage of the vesicles is performed as follows: The finger is introduced as far as possible above the lateral angle of the prostate. The diseased vesicle is then palpated. If the finger recognizes the hard lump just above the angle of the prostate (p. 238), no attempt is made to rub this away, but the vesicle above is pressed quite firmly while slowly withdrawing the finger and making very moderate lateral movements. This maneuver is repeated about a dozen times and then repeated for the opposite vesicle. No perceptible effect upon the lump will result, and usually no secretion will appear at the meatus.

If the vesicle is distended, the maneuver is the same but the result more definite. The peanut-shaped mass becomes much less prominent or even disappears entirely, and secretion may appear at the meatus.

Massage of the prostate should be performed after massage of the vesicles. The maneuver employed is either a circular motion over a given spot or a to-and-fro motion as the finger is drawn from base to apex of the lobe, or a stroking motion. Any of these methods achieves satisfactory results.

The force, the time, the frequency of massage of prostate and vesicles are rather indefinite. Our patients soon teach us that no two men massage in the same way. Generally speaking, the more acute the inflammation the more gentle should be the rubbing. Massage severe enough to be very painful or to make the patient feel faint is only very rarely necessary in intractable or relapsing cases. In Vienna the routine rule for chronic cases is to rub one minute on each lobe, quite gently, and then to express the fluid by a few strokes on the isthmus. The duration of massage is, in general, universally proportional to its severity. Massage should be repeated not oftener than every other day, not less often than once a week.

Antisepsis.—Inasmuch as the prostate and vesicles may contain gonococci, the extension of which into the urethra is quite likely to set up acute urethritis, or other bacteria that may cause bacteriuria, as a general rule the urethra should be flushed with some antiseptic after massage. The easiest way to accomplish this is by filling the bladder with potassium permanganate (1:6,000) or silver nitrate (1:8,000) before the massage, and instructing the patient to emit this afterwards. Instillation of silver salts may also be employed.

If the temper of the urethra is well known the antisepsis may be omitted in certain cases. It is then better to have the patient retain some urine with which to flush the canal after massage.

Irrigation.—Rectal irrigation may be given either by a closed tube, the psychrophore, through which the water flows in and out, or by a double-current tube. The former is a much neater instrument to use, but it does not impart so much heat (or cold) to the patient as does the double-current tube.

If no double-current tube is to be had, Tuttle's apparatus may be employed. It consists of two large soft-rubber catheters, bound or sewed

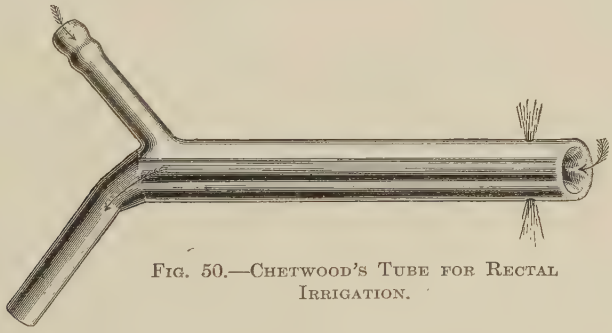

Fig. 50.—Chetwood's Tube for Rectal Irrigation.

together, side by side. The water flows in through one, out through the other. When the outlet is plugged with feces, the current is reversed. Of the special tubes, I find Chetwood's model (Fig. 50) more convenient than those of Kemp or Tuttle.

The patient fills a two-quart douche bag, attaches it to the tube, hangs the bag so that its elevation above the outflow shall be about two feet, and greases the tube with vaselin. He then seats himself toward the back of a privy seat, leans back against the wall, grasps the tube with his thumb at about its middle, opens the cut-off of the douche bag until the water flows warm through the tube, and then inserts the tube into the rectum for about half its length. He then turns the water on, and it flows into the rectum. If it does not return through the outflow, he stops the inflow as soon as the rectum feels full, pokes about with the tube until a gush of water announces that it is in the right position, then turns the water on again. It takes

from four to eight attempts before the patient learns to do the trick neatly.

The douche is usually employed once a day. The fluid is salt solution at a temperature of 120° F. Exceptionally cold water (50° F.) works better than hot.

SOLUTIONS EMPLOYED

All solutions to be employed in the urethra or bladder should be made freshly with boiled water in the manner described in Chapter III.

The following list represents the solutions usually employed, the form in which they are most conveniently kept, and the strength in which they are usually dissolved. A discussion of their use follows. The list might be doubled or trebled without being exhaustive. The remedies are classified in a purely arbitrary way. Manufacturers' claims as to silver content of the organic compounds are disregarded as being of no clinical importance.

Name.	Form.	Injection.	Irrigation.	Instillation.
Argyrol	Crystals	5–20% [1]	3 –10%	10–50%
Novargan	0.2 gm. tablets	2–10% [1]	0.5–2%	10–20%
Protargol	0.5 gm. powders	0.25–1% [1]	0.1–0.5%	1–5%
Albargin	0.2 gm. tablets	0.1–1% [1]	0.05–0.2%	1–5%
Potass. permang	1 gr. tablets		0.01–0.03%	
Silver nitrate	10% sol		0.01–0.02%	0.2–10%
Silver permang	see text			
Silver iodid	see text	10%		
Hg. oxycyanid	0.25 gm. powders		0.03–0.2%	
Zinc sulphate	1% sol	0.5–4%	0.1–0.5%	
Zinc acetat	see text			
Zinc permang	1% sol	0.2–0.5%	0.05–0.2%	
Copper sulphate	10% sol		0.02–1%	0.5–5%
Vegetable astringents	see text			
Ointments and bougies	see text			

[1] Must be retained three to ten minutes in the urethra.

First and foremost, let us condemn the use of any local anesthetic as a preliminary to urethral injection in acute gonorrhea. This masking of the natural irritative reaction is an unwarranted and dangerous procedure.

The Organic Silver Salts

War still rages as to the value of the organic salts of silver. Thus Marshall and Neave,[1] experimenting upon the Staphylococcus pyogenes aureus, showed that whereas the majority of silver salts experimented

[1] *Brit. Med. Jour.*, August 1, 1906.

with were powerfully bactericidal, argyrol showed no such effect. Cragin, comparing the effects of silver nitrate, protargol, and argyrol on streptococcus, Staphylococcus pyogenes aureus, and gonococcus, showed both the latter to be markedly inefficient except against the gonococcus, which was killed in thirty seconds by 5 per cent protargol and 20 per cent argyrol, in three minutes by 2 per cent, and in twelve minutes by 1 per cent protargol, in twenty minutes by 10 per cent argyrol. Burnett,[1] experimenting on dogs, found that neither argyrol nor silver nitrate showed any power to penetrate the urethral mucous membrane. The report of Puckner [2] and its discussion exemplifies the impracticability of classifying these salts by any laboratory standard.

The only standard is that of the clinic. The clinic decides that the organic silver salts are, by virtue of their power to destroy gonococci and their relative lack of irritation to the urethral mucous membrane, the best remedies against acute gonorrhea, and useful in chronic gonorrhea in proportion as the urethra is hypersensitive and irritable to other remedies. But in nongonorrheal or postgonorrheal urethritis, acute or chronic, the organic silver salts are useless.

Argyrol is the least irritating of these remedies, and is accordingly the most useful in acute gonorrhea. Yet even argyrol may irritate. I have seen three patients who could not employ it, and two others with prostatic abscess due to its intemperate use. Yet argyrol is so filthy that one gladly employs one of the other salts in its stead as soon as the urethra will permit. The stains of argyrol may be removed by immediate washing or by prolonged soaking in 1 : 500 corrosive-sublimate solution.

Novargan is almost as unirritating as argyrol and much cleaner. Its value has not been sufficiently tested as yet, but it seems somewhat less efficient than argyrol.

Protargol is fully as efficient as argyrol, but, in efficient strength, much more irritating.

Albargin is efficient, but somewhat more irritating than protargol.

Astringent Antiseptic Inorganic Compounds

The above clumsy title best describes a group of drugs that vary widely in usefulness and antiseptic power, but possess the common property of healing the inflamed urethra—a property only inadequately expressed by the word "astringent."

Astringent properties, in the chemical sense, are claimed for the organic silver compounds; but these exhibit very faint healing power when applied to the urethra.

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[1] *Am. Assoc. of G.-U. Surgeons*, 1903.

[2] *Jour. Amer. Med. Assoc.*, October 20, 1906.

Potassium Permanganate.—Given but a single drug for the local treatment of gonorrhea, permanganate, as it is familiarly called, would be our choice. For the irrigation treatment of acute gonorrhea its virtues are exceeded only by those of the organic silver salts. It is our best remedy to hasten the cure of a declining gonorrhea. It equals nitrate of silver as a preventive of infection when sounds are passed or the prostate rubbed. It is preëminent in the treatment of nonspecific and chronic urethritis. Yet it has its limitations. It achieves the best results when employed in weak (1 : 3,000 to 1 : 8,000) solutions and in large quantity, as an irrigation. As an injection for the anterior urethra it is distinctly inferior to many other drugs.

The statement often made, that while gonococci are present in the urethra silver salts should be employed, and after they have disappeared permanganate resorted to, is a misleading half truth. The organic silver salts are, it is true, preëminent as slayers of the gonococcus, but the inorganic silver nitrate and potassium permanganate are useful for all sorts of urethritis, except the most acute, whether gonococci be present or not.

Silver Nitrate.—On the general utility list silver nitrate stands second only to potassium permanganate. It has not served me well in the abortive treatment, and no one now uses it in advancing acute gonorrhea, excepting as an instillation for hyperacute posterior urethritis.

It is useless for anterior urethral irrigation or injection. But for posterior irrigation in urethritis it is almost as efficient as permanganate, and in cystitis it quite equals permanganate, and in nongonorrheal cases surpasses it in efficiency. Moreover, for instillation and urethroscopic application silver nitrate is used almost exclusively.

Silver Permanganate.—This salt is made by adding silver nitrate to potassium permanganate. To 500 c.c. of 1 : 8,000 solution of the latter I usually add from six to ten drops (minims) of a 10-per-cent solution of the former.

I have found it useful only as a posterior irrigation in chronic cases, as an alternative for either of its components alone.

Silver Iodid.—This salt was introduced by Siter and Uhle.[1] It is employed in a 10-per-cent emulsion in mucilage of quince seed. It does not appear to be useful in chronic gonorrhea, and the claims made for it in the treatment of acute gonorrhea have not been widely verified as yet. I have not employed it.

For the treatment of chronic cases:

The urethra must be completely filled with the injection through a blunt nozzle syringe at least three, and if convenient four, times daily,

[1] *Univ. Pa. Med. Bull.*, May, 1905.

each time after urination. To completely fill the canal at least three syringefuls of the preparation are needed, between each injection the meatus being held closed. The fluid is retained in the urethra for two or three minutes. He is instructed to return twice weekly for total bladder irrigation (with 1:10,000 permanganate solution) as at the first visit. (La Roque.) [1]

Mercury Oxycyanid.—The cyanate or oxycyanid of mercury is highly spoken of by European writers for the treatment of nongonorrheal urethritis. I have repeatedly tried it and found it excessively irritating and singularly inefficient.

The Zinc Salts.—The zinc salts have been little used except as injections for the control of chronic anterior urethral discharges. They rarely cure, but they control the discharge better than any other remedy and are thus of great assistance by the encouragement and sense of cleanliness they impart to the patient (but not, it is to be hoped, to his physician), while giving nature and the more efficacious local treatments time to effect a cure.

Zinc sulphate is the most popular of these salts. It is usually employed in a 1-per-cent solution or even stronger, though I fancy it is as efficacious in much greater dilution.

Zinc acetate is in my hands the most efficacious of the zinc salts. I employ the following formula almost without variation. The combination throws down an insoluble zinc sulphate which helps to retain the acetate in the urethra.

℞ Zinci sulph.....	00.2 gm.	gr. iij;
Liq. plumbi subacetat. dil.....ad	100.0 c.c.	℥ iij.

M. Shake.

Zinc permanganate is a hygroscopic salt and is, therefore, best kept in solution. At a strength of 1:2,000 it is extremely efficacious; sometimes more so than the acetate. It is possible, but apparently unnecessary, to use it in much stronger solution.

Other Astringents. — The following composite preparations are recommended by various authors, as follows:

℞ Hydrarg. chlorid. corrosive.....	gr. ss;
Acidi carbolici.....	gr. xii;
Zinci sulphocarbolate.....	gr. xii to ℥ j;
Boroglycerid (25 per cent).....	℥ ij;
Aquæ.....q.s. ad	℥ vj.

(White and Martin.)

[1] *Therap. Gaz.*, 1906, xxiii, 725.

℞ Zinc acetate }
Acid tannic } ..... āā gr. xx;
Aquæ rosæ ..... ℥ jv.
(Ibid.)

℞ Zinci sulphatis ..... gr. xv;
Plumbi acetatis ..... gr. xx;
Tr. opii. }
Tr. catechu } ..... āā ℥ ij;
Aquæ ..... ad ℥ vj.
(Brou.)

℞ Zinci sulphatis. }
Pulv. alum } ..... āā gr. jv. ad gr. xij;
Acid carbolic ..... gr. jv;
Aquæ ..... ℥ jv.
(Ultzmann.)

℞ Zinci sulphatis ..... gr. xij;
Resorcin ..... gr. xxjv;
Aquæ ..... ℥ jv.
(Morton.)

℞ Acidi nitrici ..... ♏ iij to xv;
Aquæ ..... ℥ viij.
(Baumann.)

℞ Cupri sulphatis ..... 0.20 gr. iij;
Alum crud. ..... 1.00 gr. xv;
Aquæ ..... 200.00 ℥ vij.
(Kreissl.)

Copper Sulphate.—This salt is so irritating that it is little used. But it seems to have decidedly beneficial effects upon intractable chronic urethritis. When all else fails, copper sometimes succeeds. But it must not be employed upon oversensitive or nervous patients.

Vegetable Astringents

The vegetable astringents are legion. Almost every known fluid, from hot and cold water to tea and claret, has been employed in the course of a gonorrhea that terminated in a cure. These remedies are only employed as injections in chronic or nongonorrheal urethritis as substitutes for the zinc salts. I am not enthusiastic over any of them.

The following are advised:

℞ Extr. hydrast. fl.[1]
Bismuth subcarb.
Boroglycerid (25 per cent) ..... āā ʒ vj;
Aquæ destill. ..... ad ℥ vj.
(White and Martin.)

℞ Ichthyol ..... gr. xx to ʒ jss;
Aquæ ..... q.s. ad ℥ jv.
(Baumann.)

℞ Berberine hydrochlorate ..... gr. v;
Aquæ ..... ℥ viij.
(Belfield.)

Ointments and Drugs

The application of urethral medication in an oily or greasy form has seemed to many an ideal way of treating chronic urethritis. Results have generally fallen below expectations. I have derived no advantage either from ointments or soluble bougies. Young,[2] who has reviewed the subject exhaustively, employs lanolin as excipient and uses the following formulæ:

For cases with marked epithelial changes, salicylate acid (0.5 to 1 per cent).

For "less severe cases," iodoform (10 per cent), silver nitrate (1 to 2 per cent), or boric acid (10 per cent).

For cases with considerable glandular involvement, protargol (2 to 5 per cent), or bichlorid of mercury (1:10,000), or formaldehyd (1:5,000).

Janet, Caspar, Finger, and Bazy are among the other advocates of the method.

Formulæ similar to the above are made up as suppositories, to be inserted into the anterior urethra. I have not found them as useful as injections.

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[1] The "colorless" preparation is advised, but since this has been shown to be but a dilution of the colored drug, it seems better not to employ it. Hydrastis leaves an indelible yellow stain on linen.

[2] Johns Hopkins Hosp. Reports, 1906, XIII, 115.

CHAPTER XIX

SYSTEMIC TREATMENT OF ACUTE URETHRAL GONORRHEA

The efficacy of the silver albuminates in repressing urethral gonorrhea leads many practitioners to forget the old "methodic" treatment, the sole reliance of our fathers. The methodic, or systemic, treatment of acute gonorrhea has indeed been relegated to second place; yet it is still important, not only when repressive local treatment is inapplicable, but also as an accessory to this local treatment. The hygienic and dietetic part of the treatment is of the utmost importance. If disregarded, the best-directed efforts may miscarry.

CLEANLINESS

The parts should be washed as often as required, soap and warm water being as good as an antiseptic solution and more readily at hand. The discharge should be kept from smearing the underclothing. If the foreskin is long a little absorbent cotton may be tucked into its orifice and renewed after each urinary act, or the glans penis may be thrust through a slit in the center of a small square of gauze until the slit lies snugly behind the corona glandis; thus held in place, the gauze is folded forward over the glans penis, covered by replacing the foreskin, and left puckered up and long enough to protrude in a bunch in front of the preputial orifice. If the prepuce is short, an apron of old cotton or linen doubled may be fastened to a string about the waist or pinned to a suspensory bandage, and the entire genitalia wrapped up in this; or one of the penis bags furnished by the shops may be employed, the bottom to be kept supplied with renewed portions of absorbent cotton.

Inasmuch as suspension of the testicles is advisable as a preventive of epididymitis, a "jock-strap" should be worn. This acts incidentally as a bag to contain the gauze or cotton garnishing the meatus.

Finally, the patient must be told the danger to his eyes from contamination with his urethral pus, and cautioned to touch the genitals as little as possible and to *wash his hands thoroughly with soap and water every time he has touched his penis.*

DIET

The rigorous diet usually prescribed excludes all alcohol, spices, rich and indigestible sauces and foods, fruit, coffee, tea, and sparkling water. I have found it of no benefit to the patient's urethra to be so strict, and a great encouragement to his mind to permit a greater latitude. Alcohol, spices, and condiments must, of course, be prohibited, and it is well to specify ale, beer, cider, and ginger ale, besides insisting that any substance which burns the palate as it enters the body will burn the urethra as it issues forth (we speak, of course, of chemical, not of physical heat). Indigestion, whether from overeating or from indiscreet eating, is harmful, and fruits, especially lemons and grape fruit, as well as asparagus, are apparently irritating unless eaten in moderation. But there is no reason to prohibit these absolutely nor to prohibit tea or coffee at all. Some sparkling waters, such as Vichy Celestins, are distinctly beneficial.

REST

Physical rest is most important. Were it possible for the business of the world to be transacted with all the sufferers from acute gonorrhea in bed, and were rest in bed not the very worst thing for the state of mind of these same sufferers, it would be wiser to place them all upon their backs. But, taking the world as it is, the best plan is to urge each patient to rest as much as may be; to ride rather than to walk, to sit rather than to stand. Railroad and automobile trips seem, however, a peculiarly injurious form of locomotion.

SEXUAL HYGIENE

During the acute stage absolute continence is essential, and this should be extended at least two weeks after the cessation of all discharge, with the avoidance of anything liable to induce sexual excitement—association with women, racy books and pictures, erotic thoughts *et id genus omne*.

Such is the general rule; yet I have known patients accustomed to frequent sexual intercourse to be constantly distressed by painful erections unless they relieved their sexual tension by cohabitation (with a condom). Such license is extremely risky. Massage of the prostate and vesicles cannot replace it.

DILUENTS

The patient should drink, between meals if he is dyspeptic, about eight glasses of water a day. Ordinary drinking water suffices, but, if he can afford it and it does not prove too diuretic, an alkaline diluent, such as Vichy Celestins, is preferable.

But here again common sense must temper routine practice. In acute gonorrheal cystitis and in very acute posterior urethritis more harm may be done by the muscular straining attending the frequent repetition of the urinary act than is atoned for by any amount of dilution of the urine.

INTERNAL MEDICATION

The drugs that may be effectively exploited to combat acute urethral inflammation belong to five orders:

I. Urinary antiseptics.
II. Alkalies.
III. Demulcents.
IV. Anodynes.
V. Balsamics.

I. Urinary Antiseptics

Urinary antiseptics, such as hexamethylenamin, methylene blue, salol, benzoic acid and the benzoates, boric acid and the borates, have little influence upon acute urethral inflammation. Theoretically, they ought to be of paramount importance, since suppuration is a process always associated with, indeed caused by, germs of one sort or another; but practically these substances, so valuable in suppurative conditions of the urinary tract above the bladder, are nearly useless below that point, whether because their bactericidal efficiency is slight, or because their sojourn in contact with the inflamed urethral wall is limited, or because the bacteria are shielded from the antiseptic action of the medicated urine by the tissues in which they lie. The value of hexamethylenamin and of methylene blue in acute gonorrhea has been vaunted. In my opinion it is slight; so slight that it does not deserve consideration.

II. Alkalies

The virtue of alkalies in the treatment of urethral inflammations depends rather upon the condition of the urine than upon the grade of the inflammation. The urine, normally acid and often dense, is, *ipso facto,* harmful except in so far as it washes the urethra, and the alkali is negatively a very good thing, but good only when required to counteract acidity. In other words, there is no specific action whatsoever in the alkalies. They do not in the least control suppuration. If one had two burned hands, and placed one of them in vinegar and water and the other in a watery solution of bicarbonate of soda, he would doubtless prefer the sensations experienced in the hand immersed in the mild alkali, and so it is with the urethra.

Patients having normally bland, alkaline, dilute urine, and there are many such, stand in no need of alkalies, and, indeed, may occasionally be injured by them, by indigestion or by having the urine rendered too alkaline.

When, however, the urine is brown, dense, overacid, *a fortiori* if it contains uric-acid crystals which, whirled along in the escaping torrent, act as a sand-blast upon the sensitive urethra, an alkali is balm indeed, and often alone quite capable of affording material comfort.

But there are certain conditions to its use even in these cases, a routine employment indicating carelessness or incompetence on the part of the surgeon. These conditions are easily formulated. When the urine is acid an alkali is indicated. If the urine be also dense a diuretic alkali is called for; if light (sp. gr. 1.015 or thereabouts), the diuretic quality is not needed. If the urine be alkaline, no alkaline medicine is needed, for dilution, if required, can be produced by other means.

Alkalies produce the greatest effect relative to the size of the dose, if administered toward the end of the second hour after eating.

Bicarbonate of soda is the mildest of the alkalies. Its chief virtue is that it aids digestion, while the other alkalies impede digestion more or less. Dose, 0.50 to 1 gram. It is often prescribed under the form of tablets.

Sweet spirits of niter (spts. etheris nitrosi) is notable for its anodyne rather than its alkaline properties. It is chiefly employed for the slight irritation of the bladder so common in women.

Potassium citrate, Potassium acetate, Liquor potassæ.—These three salts are employed more than any others as urinary alkalinizers. The citrate is the most efficient as an alkali, but irritates some stomachs, the liquor the most anodyne, the acetate the most diuretic. Therefore the liquor is most useful in acute cases, and the citrate in chronic cases. The acetate is a stronger diuretic than the citrate, but I have found it also more irritant to the stomach. The dose of each drug is about 0.5 gram in a considerable quantity of water. The disagreeable taste of the liquor is well disguised by sirup of cinnamon.

Bromid of potassium acts as an alkali and is sometimes efficient in controlling the smarting upon urination.

III. Demulcents

Demulcents are much less used now than formerly, but occasionally are comforting when combined with an alkali. To this class belong flaxseed tea, gum water and elm-bark water, the various teas of fluid extracts made from buchu, pareira brava, uva ursi, triticum repens, and cornsilk.

IV. Anodynes

Anodynes are called for to moderate pain on urination, and for this bromid of potassium or the tincture or fluid extract of hyoscyamus generally suffices. A favorite old-fashioned prescription is:

℞ Liq. potassæ	8.00–25.00	gr.	ʒ ij–vj;
Tr. hyoscyami	15.00–35.00	"	ʒ ss–j;
Syr. cinnamon ...q. s. ad	100.00	"	ʒ iij.

M.

Sig.—Teaspoonful in water two hours after each meal.

For intense *chordee* lupulin in doses of 2 to 4 grams taken upon retiring is sometimes effective, or a similar dose of the bromid of potassium. The coal-tar products are useless. Codein feeble, opium risky. Hot water is a good preventive, cold water a quick relief (as stated below). The patient should sleep lightly clad in a cool room.

For Painful Urination.—The anodyne mixture given above is excellent. Codein or bromids may be added for a severe case of acute cystitis. It is an advantage to instruct the patient suffering from this complication not to empty his bladder completely, but to let the last of the urine dribble away without the aid of the distressful piston stroke. The instruction is hard to follow, but it may afford great relief. The uses of water in this connection are mentioned below. The rôle of the prostate must not be forgotten, and if all else fails, local treatment (p. 230) or even operation may be resorted to.

Hot water is of value in various ways. When the pain on urination is intense it may be somewhat moderated by immersing the penis in very hot water and urinating into it. Prolonged soaking of the penis, just before retiring, in water as hot as can be borne, will often prevent or moderate chordee during the night.

A *hot hip bath* is full of comfort for the patient with any form of acute prostatic, vesical, or seminal vesicular inflammation. Such a bath may be repeated every few hours. It should be short, not lasting more than five minutes. The temperature of the water to begin with should be near 104° F., and after the patient is in the bath more hot water should be added until the temperature of the bath is as high as he can tolerate.

Iced water is useful when the penis is erect and in chordee, but not when the penis is relaxed before retiring, as this rather encourages erection later in the night. In chordee the patient naturally urinates at once, if he can, and then by pouring iced water over his turgid and unruly member, or by placing it alongside a cold piece of metal, he strives to reduce it to subjection. To break a chordee is to invite stricture.

V. Balsamics

Some form of balsamic should be administered throughout the acute stage of gonorrheal urethritis. It may or may not be obviously beneficial in a given case, but it is never harmful if the single rule is observed, that the medicine should never disagree with the patient's digestion. In order to benefit the urethra it should not upset the stomach.

The products of the synthetic laboratory, such as gonosan (two capsules three times a day), arrhovin (same dose), or santyl (same dose), are perennially hailed as a prodigious advance over the old crude method of balsamic medication. Careful trial of the drugs cited has not convinced me that they are any more or any less potent than the more familiar drugs contained in the capsules compounded by American firms.

Among the older balsamics oil of yellow sandalwood, balsam of copaiba, cubeb, and oil of wintergreen are the only ones of proven value. Eucalyptol, kava-kava, matico, pichi, and many others are variously rated, but are not generally employed.

If sandalwood oil in small quantity gives a man so severe a pain in his back that he can neither exercise nor sleep, and if copaiba in moderate dose so upsets his stomach that he is constantly seminauseated, or if he easily gets copaibal erythema, he certainly cannot derive proper advantage from these drugs, and it is folly to push them. But, on the other hand, when the balsams agree they are exceedingly helpful, and their dose may be pushed with advantage up to the limit of satisfactory digestion.

Sandalwood Oil.—The preparation made from yellow sandalwood is probably better than that made from the red, but both have merit. The oil, however, is expensive, and often adulterated. Modern fastidiousness demands that it be prescribed at meal times in capsules, and the markets are flooded with these, soft and hard, containing 5 and 10 minims, and in all sorts of combinations with other balsams and with salol, with pepsin, etc.

The dose of sandalwood oil should be at least 0.7 gram (10 minims) three times a day. (It may be pushed to 2 grams (30 minims) four times a day; rarely, however, is so much required.) Even the lowest dose sometimes upsets digestion or gives the distressing pain in the back, which calls for a diminution in dose or a change of drug.

If a liquid be preferred to a capsule the alkali and balsam are easily combined.

℞ Potass. citrat.	8.00–25.00	gm.	ʒ ij–vj;
Ol. santal	15.00–25.00	"	ʒ jv–vj;
Syr. acaciæ	30.00	"	℥ j;
Aquæ menth. pip. q. s. ad	100.00	"	ʒ iij.

M. Shake.

Sig.—Teaspoonful in water two hours after eating.

Copaiba may be prescribed (4 to 10 grams) instead of sandalwood oil in this combination late rather than early in the disease, and fluid extract of hyoscyamus or deodorized tincture of opium if required as an anodyne.

This dose is easier to take than the time-honored Lafayette mixture—Heaven knows why that warrior allowed his name to become attached to such a compound!—and the citrate of potash seems to do better work than the niter and the liquor potassæ of that mixture. Bicarbonate of soda may substitute the citrate of potash when a diuretic effect is not desired, and wintergreen or licorice flavors be substituted for the mint. Copaiba more than sandalwood oil, however, demands the capsular form of administration. It often nauseates, sometimes occasions diarrhea.

Copaibal erythema consists in the appearance of closely aggregated, slightly elevated, red blotches scattered over the whole trunk. They itch and are hot and tingling, like urticaria—features distinguishing this eruption from roseola, with which the timid are prone to confound it. It is easily cured by a discontinuance of the drug, an alkaline laxative, a few warm baths containing some bicarbonate of soda (3 ounces to 10 gallons), dusting the body with powdered talcum, and applying twice a day—

℞ Acidi carbolici ..... 4.00 gm. ℥ j;
Spts. rect. ..... 150.00 " ℥ v;
Aquæ .....q. s. ad 250.00 " ℥ viij.
M.
Sig.—Lotion.

Or,

℞ Menthol ..... 4.00 gm. ℥ j;
Spts. rect. ..... 50.00 " ℥ jss;
Aquæ .....ad 100.00 " ℥ iij.
M.
Sig.—Lotion.

When copaibal erythema appears, the patient feels ill, has fever, etc., and the discharge diminishes greatly or ceases. But it returns as the eruption fades. The eruption does not mean that the drug must be given up entirely, but only that it must be considerably reduced in quantity.

The headache and giddiness, and the urticaria caused by copaiba need only be mentioned. They are due to indigestion.

Cubeb is a stimulant as well as a balsamic. It agrees with most stomachs, but in large dose sometimes irritates the bladder slightly. Hence, it is more applicable to the declining than to the advancing stage of urethral inflammation. The powder is often spoken of, but rarely

given, in this country. The fluid extract is better, in half-teaspoon- to teaspoonful doses, hot; the oleoresin, in capsules, perhaps best in the dose of 0.3 to 1 gram (5 to 15 minims) (1 to 3 capsules).

Wintergreen oil, or its synthetic substitute, the salicylate of methyl, in 0.75 gram (10-minim) capsules, one or more at a dose, seems helpful in some cases of subacute urethritis, especially in rheumatic subjects, and *eucalyptol*, in 5-minim capsules, one or two at a dose, if there be much debility, especially for chronic malarial cases. *Matico* seems a fancy, and is generally used in combination with something else, while *pichi*, at one time fashionable and seemingly astringent, appears to have been lost of late.

Fluid extract of *kava-kava* in 0.5- to 2-gram doses is, apparently, sometimes helpful.

The balsamic remedies have been found ineffective when administered locally. They undergo a change in passing through the kidney. Most of them give an especial odor to the urine. The excreted urine exercises a local action [1] upon the inflamed surface of the urethra; consequently the balsams are useless in female gonorrhea, unless the urethra or bladder be involved.

INSTRUCTIONS TO PATIENTS

Of late years the commendable practice has arisen of distributing to dispensary patients, suffering from venereal diseases, a card indicating the chief dangers of the disease and the precautions they personally must take to encourage speedy cure and to protect their fellows. The following list for this purpose is copied, with but few minor changes, from that employed by Follen Cabot:

Instructions to Those Having Gonorrhea or "Clap."—Gonorrhea or "clap" is a local contagious disease which requires treatment until the physician pronounces you cured.

To avoid infecting others and to prevent complications, a bubo, stricture, swollen testicles, etc., the following rules should be observed:

1. During the first few weeks walking should be limited. When the discharge is profuse you should keep off your feet as much as possible.

2. Do not use alcohol in any form, as it always prolongs the disease.

[1] As has been proved when large fistula in the floor of the urethra permitted the urine to be turned off, the part behind the opening getting well first, and the anterior urethra being subsequently cured by injection with the patient's own urine, freshly passed and full of modified copaiba. I do not know that this has been demonstrated except for copaiba; and yet, strangely enough, Steinschneider and Schaeffer (cited by Sée) found that the urine of patients who had taken copaiba or salicylate of soda did not show bactericidal qualities—while iodid of potassium possessed more merit in this respect.

Drink milk, tea, coffee, and from six to eight glasses of water during the day.

3. Avoid all sexual relations until you have been pronounced cured by your physician, as the disease may be given to a woman even after the discharge has apparently ceased. When it is present you should avoid sexual excitement, as erections always aggravate the disease.

4. Always wash the hands after handling the parts. The discharge, if carried to the eyes, will cause blindness.

5. Sleep alone, and be sure that no one uses any of your toilet articles, particularly towels and wash cloths.

6. Never lend your syringe to anyone, and as soon as you are well destroy it.

7. Be sure that the bowels move every day. If they are inclined to be constipated, take a laxative.

8. Do not use mustard, pepper, horseradish or stimulating sauces on your food. Do not drink ginger ale.

CHAPTER XX

LOCAL TREATMENT OF ACUTE GONORRHEA

The local treatment of acute gonorrhea comprises five entirely distinct subjects, viz.:

The Preventive Treatment.
The Abortive Treatment.
The Repressive Treatment.
The Terminal (Expectant) Treatment.
The Treatment of Complications.

THE PREVENTIVE TREATMENT

The man who practices promiscuous cohabitation sooner or later catches gonorrhea in spite of every precaution. Though the condom is usually a safeguard, it sometimes breaks, and once in a great while one is consulted by a victim who alleges he was infected in spite of its protection. The infection in such cases doubtless results from preliminary skirmishing.

Some measure of safety is afforded by urination and thorough washing with soap and water immediately after cohabitation. To this any one of the following therapeutic measures adds a far greater assurance of safety:

Instillation into the meatus of a few drops of 20 per cent argyrol or 5 per cent protargol.

Irrigation of the anterior urethra with permanganate of potassium (1:1,000).

Injection and retention for five minutes of 20 per cent argyrol or 1 per cent protargol.

The safety afforded by any of these is approximate but not absolute. The treatment should be employed within twelve hours of the contact and should not be repeated. A traumatic urethritis, lasting a day or two, may result.

THE ABORTIVE TREATMENT

In the production of chronic urethritis the abortive treatment has taken the place of the sound of our forefathers.

In exceptional cases it is possible to abort gonorrhea. Indeed, in some cases gonorrhea almost aborts itself. But *it is almost impossible to abort a first gonorrhea,* and often impossible to abort subsequent attacks. After experimenting with every method of aborting gonorrhea I ever heard of, it is my present conviction that *the surest way to abort gonorrhea is not to try to abort it.* The repressive treatment every now and then results in a rapid cure. Last winter I had the pleasure in a single week of curing three cases of acute true gonorrhea, two of them within seven and a third within twelve days of its inception. But I treated no two of them alike; they were all secondary gonorrheas. I made no attempt to abort any of them, and in the six months since that time I have cured but one case within four weeks.

In contradiction to my own opinion, let me quote excellent authority as follows:

It is, therefore, clear that the abortive treatment should not be attempted except in the very earliest period of a gonorrhea—that is, when the tickling of the meatus, the drop of clear or slightly cloudy discharge, made up of mucus and epithelium, and the extracellular position of the gonococci denote that the inflammatory process has not extended deeply. A red or injected meatus with swollen, everted lips, a turgid glans, marked ardor urinæ, and particularly free purulent secretion, constitute absolute contra-indications to this treatment, even if the case is seen early in its course. The injection should be made of 5 grains of protargol to the ounce of distilled water. This is not strong enough to produce an inflammation of sufficient depth and intensity to be followed by subsequent cicatricial contraction. The patient first urinates, and has ten drops of a 4 per cent solution of eucaine injected into the urethra. Into the meatus, the lips of which are held open, several drops of the protargol solution are allowed to fall. Then the nozzle of the syringe is introduced and about one dram of the solution is injected, and is held in for three minutes by withdrawing the syringe and compressing the meatus. This injection is repeated every two hours; each time the ounce bottle becomes half empty it is filled to the top with distilled water. At the end of the first day the dilution becomes 1 to 200, at the end of the second day 1 to 800, at the end of the third day 1 to 3,200. The discharge diminishes and becomes mucoid, the gonococci disappear, and, if the treatment prove successful, there may be complete recovery in seven days. Even though the gonococci disappear, a slight discharge often persists. (White and Martin, eighth edition.)

Bierhoff [1] reviews the opinions of various authorities, and claims 50 per cent cure for the following modification of the method of Frank and Lewin (who report 45 per cent cures):

[1] *Med. News,* 1904, lxxxiv, 488.

A microscopical examination of the secretion was first made. If the discharge was slight, and if the majority of the gonococci still were extracellular, then the protargol solution was employed in the strength of $\frac{1}{6}$ to $\frac{1}{3}$ per cent. If the discharge was at all pronounced, or if the greater part of the gonococci were intracellular, then a $\frac{1}{3}$ to $\frac{1}{2}$ per cent solution was used. The method was employed, naturally, only in those cases in which the second urine was clear. After urination, the urethra was anesthetized by an injection of a mixture of 4 c.c. of a 1-per-cent cocain solution and 4 c.c. of a 1-per-cent protargol solution. After this the anterior urethra was cleansed with 150 c.c. of the protargol solution. Following this, an irrigation of the whole urethra was made, according to Janet's method, with 150 c.c. of the solution. The patient then emptied his bladder of the irrigated fluid. This irrigation of the entire urethra, with immediate emptying of the fluid, was repeated from one to three times in the same sitting, so that the urethra was flushed four to eight times. In addition, the patient was given a solution of protargol, $\frac{1}{2}$ per cent, with which he was instructed to inject three to five times during the day, and to retain the fluid ten minutes each time. During the succeeding days, if the gonococci had disappeared, the strength of the solution and the quantity of fluid injected were diminished, to be suspended, if the result was positive, on the fourth or fifth day, at the latest. The injections by the patient were also diminished and suspended in a similar manner. Then followed the usual provocative tests and control examinations.

Kreissl employs the following treatment for every case of acute urethritis of less than two days' duration:

After irrigating the anterior urethra with a hot boric-acid solution a constricting rubber band should be placed around the penis at the penoscrotal junction, and one dram of a 4-per-cent protargol solution injected and retained for five minutes. For irrigation with the boric-acid solution a piston syringe and a sterile elastic catheter should be used. No pressure to distend the urethra should be applied and the fluid should commence flowing through the catheter before it enters the urethra, whereby the dissemination of infectious material is avoided.

During the following eight days the anterior urethra should be irrigated in the same manner with a pint of a 1:3000 hot nitrate-of-silver solution, once a day. The discharge, if there be any, is examined microscopically every day. If no gonococcus be present in the last five specimens, the treatment may then be discontinued; otherwise, the systematic treatment for gonorrheal urethritis should be commenced.

Champion [1] has cured a number of cases by injecting a 2-per-cent solution of silver nitrate while pinching the urethra at a depth of two

[1] Personal communication.

inches. The solution is permitted to escape immediately, and after an interval of four or five minutes 2 per cent cocain is injected and retained until the pain begins to diminish. One similar treatment is given on each of the two days following, but 1 per cent silver nitrate is used on these occasions.

Excellent results are also attributed to permanganate employed in the routine way as described below.

REPRESSIVE TREATMENT

The repressive treatment of acute gonorrhea consists in the employment of local treatment calculated to control the inflammation; but with the prime object of lessening the symptoms, the complications, and the prospects of chronicity, not of cutting short the acute attack. The systemic treatment described in Chapter XIX is always employed. Repressive treatment occasionally and quasi-accidentally results in abortion of gonorrhea. Indeed, I believe it so results quite as often as the abortive treatments detailed above, while it has the supreme advantage of leaving those cases that are not aborted soothed rather than irritated and in the best possible condition to weather the weeks to come.

Cases Suitable to Repressive Treatment.—The physician unfamiliar with the local treatment of urethral disease can expect but little success with the repressive treatment of gonorrhea. The expectant treatment will give him better results.

The physician moderately familiar with the subject should undertake this treatment with fear and trembling. He should apply it at first only to cases that he can absolutely control, who apply for treatment during the initial stage of the disease, before the meatus is much swollen, the discharge frankly purulent, the deeper portions of the urethra infected, or the pain on urination or erection at all marked. This admits most cases from one to three days old.

The expert will determine how far his personal success permits him to disregard the above rules. None of them are absolute to him, so long as he proceeds gently and is in no hurry to get the patient well.

Choice of Repressive Treatment.—There are two entirely distinct types of repressive treatment, viz.: injection of organic silver salts and irrigation with potassium permanganate. Certain practitioners employ them simultaneously. In my experience the silver salts have proven distinctly superior to the permanganate (which I used exclusively for three years), and are most efficacious when used alone. Permanganate reduces the inflammation much more rapidly and clears the urine far more brilliantly than the silver salts, but gives a much larger proportion of chronic gonorrheas.

Organic Silver Salts

A Routine Treatment.—I usually employ 10 per cent argyrol throughout. The patient, after urinating, injects 8 c.c. of this into the urethra at least three, at most four, times a day. The intervals are made as even as possible, and no interval of less than three hours is permitted. The injection is retained ten minutes by the watch, unless this excites pain, in which event the duration may be reduced to five or even three minutes (or the strength of the solution reduced).

The patient reports every day or every other day for the first week and but twice a week thereafter, until in the fourth or fifth week the time for terminal treatment arrives.

If all goes well, the discharge disappears in from one to three days. The first urine becomes almost clear, but never quite sparkling. The second urine remains sparkling. There are no subjective symptoms.

In from five to ten days there is often a sudden change for the worse. The discharge increases, the urine becomes more purulent, there may be some swelling at the meatus, and pain on urination and injection. This indicates either that the urethra is irritated by the injections or that the gonorrhea is escaping control. Injections should, therefore, be completely stopped. Twenty-four hours later the patient reports. The symptoms are either better or worse. The discharge is examined for gonococci.

If the symptoms have diminished and no gonococci are found, no injections are given and the patient reports daily, each day carrying home two slides to be smeared with the morning discharge and examined for gonococci. So long as he continues to improve and gonococci do not appear, no more local treatment is given. If gonococci reappear the injections are resumed as before. If they do not, and the urine does not become sparkling in three or four days, a few irrigations, once a day, with permanganate complete the cure. If the urine remains sparkling for four days the patient is probably cured. He is dismissed for three days and the cure verified in the usual way (p. 184).

If the symptoms have diminished but gonococci reappear, the treatment by injection is resumed.

If the symptoms have increased or remained stationary, gonococci will almost invariably be found. The decision whether or not to abandon the repressive treatment now depends upon the patient's condition. He should be treated as though this were his first visit, by injections or by expectant treatment.

At the end of the first or second week 1 : 200 protargol solution may be substituted for the argyrol. Its sole advantage is cleanliness.

At the end of the third or fourth week an anterior irrigation of permanganate may be substituted for one of the silver injections every day

or every other day. If this seems to reduce the amount of pus, the patient is given an injection of zinc acetate or permanganate to use once a day, while continuing to use the silver salt twice a day. He shall be carefully instructed *not* to retain the zinc.

This brings us to the terminal treatment (p. 226).

If the Case is Seen Very Early.—If the case is seen at the very outset, a mild attempt at abortion may be made by applying the argyrol in 20 per cent solution four to six times a day (but no oftener) for ten minutes. This can be continued for no longer than two days, after which the injection is stopped for twenty-four hours and the treatment continued as above indicated.

If Seen Very Late.—If the case is not seen until it is well under way, local treatment will, of course, be begun very gingerly, using 5 per cent argyrol for two or three minutes only for the first day or two, until the sensitiveness of the urethra abates sufficiently to permit of stronger and longer injections.

Treatment of the Posterior Urethra.—The urine, passed in two glasses, is carefully examined at each visit. The first appearance of haziness (due to pus) in the second urine passed shows involvement of the posterior urethra. This occurs in less than half the cases. It must be treated as follows:

If the anterior urethritis is not very well controlled, no treatment of the posterior urethra is required at the first appearance of pus in the second urine. Local treatment of the anterior urethra is continued, and if this promptly brings the anterior inflammation under control, the posterior urethra is attacked as described below. If the anterior urethritis is not controlled before the posterior urethra begins to show subjective symptoms, the physician must elect one of two courses, in accord with his prospect of success. If the anterior urethritis is quite uncontrolled the repressive treatment should be abandoned; if there is still prospect of controlling it, the posterior urethra should be attacked, as described below. When in doubt stop all local treatment.

If the anterior urethritis is well controlled when pus first shows in the second urine, the posterior urethra should be promptly attacked with instillations once or twice a day of 20 per cent argyrol, 1 c.c. to a dose; or 0.5 per cent protargol, 0.5 c.c.; or 0.2 per cent silver nitrate, 0.2 c.c. (3 minims), once a day; or by posterior irrigation (very small catheter or very gentle force) with protargol (1:2,000), argyrol (1 per cent), or permanganate (1:8,000), once a day.

The selection of treatment for the posterior urethra depends upon the experience of the physician and the previous history of the patient.

If the posterior urethritis begins to show symptoms in spite of this treatment, the patient may be put to bed, hot sitz baths or rectal douches administered twice a day, and the treatment continued. If the symp-

toms still progress, or if the patient is unable to rest, all local treatment should be discontinued, and the case treated as one of acute posterior urethritis.

Criterion of Success.—The test of the success of repressive treatment is diminution and disappearance of the patient's subjective symptoms (pain or discomfort). The patient must be impressed with the fact that the success or failure of the treatment is in his hands, and that the sign of danger is pain, the cause of pain trauma. He must be gentle in injecting, gentle in compressing the meatus, and should not repeat an injection in case a first effort fails.

Pain is never the same in any two cases. To say that an injection of argyrol to be efficient should be painless, is obviously untrue. But *each successive injection should be less painful than its predecessor, and the appearance of any new or increased pain at any time is the one signal that calls for immediate consultation.*

When Treatment Fails.—If pain does not diminish with repeated injections, or if posterior urethritis becomes uncontrollable, all local treatment must be stopped. The occurrence of periurethral abscess, balanitis, or lymphangitis does not call for cessation of local treatment.

Other Methods of Treatment.—To develop a system of repressive treatment for acute urethral gonorrhea takes a year or more of personal experience. During that time one's practice incessantly varies, and, having developed a system, the variation continues. New impressions are received from each case, and scarcely any two cases are treated in the same way. Therefore the practice of no two men can positively agree. The following methods of repressive treatment are therefore copied directly from the various authorities named.[1]

Kreissl says:

> Inject $\frac{1}{8}$ per cent solution of protargol and retain it for one minute, repeating the treatment every two hours during the day and twice during the night. . . .
>
> After three days a $\frac{1}{4}$ per cent solution should be injected every three hours during the day and once during the night. At the end of the first week the strength may be increased to $\frac{1}{2}$ per cent, to be injected every four hours and retained for five minutes, while the night injection may be discontinued. At the beginning of the third week the same solution may be injected three times a day and retained for five minutes at a time. At the beginning of the fourth week, when the secretion will be found to contain mostly epithelial cells, no, or but a few, leucocytes, and no gonococci, an astringent and mild antiseptic may be substituted for the morning and noon injection with protargol, but the latter should still be used before retiring.

[1] Most text-books are so totally indefinite as not to merit quotation.

Klotz [1] makes retrograde injections with:

A somewhat enlarged edition of the old Braun's intrauterine syringe. It is made of hard rubber with a glass barrel of about 3 c.c. capacity; the syringe ends in a blunt conical point, which fits into the base of a thin hard rubber tube, slightly bent toward the olive-shaped point, of 16 to 18 of the French scale. The opening of the tube is located in the side of this bulb, so that the fluid is not easily projected beyond the point of the syringe itself. A Keyes's or Ultzmann's syringe is used where the meatus is too narrow, or in exceptional cases a piece of very fine elastic catheter, instead of the hard-rubber tube.

An injection of some silver solution is immediately made in the concentrations of $\frac{1}{8}$ to $\frac{1}{4}$ per cent of the nitrate, 2 per cent of protargol, 1 per cent albargin, etc. The fluid is deposited from 3 to 4 inches from the meatus. A second injection is made of a slightly stronger solution if the first one does not cause much burning. After removal of the syringe the meatus is kept closed for several minutes, during which the fluid is distributed as much as possible over the mucous membrane by compression and manipulation of the penis, and is then allowed to ooze out, some absorbent cotton being placed before the orifice. When the glans is covered by the prepuce, the entire surface should be wiped out with the silver solution, and the preputial cavity should be kept clean to prevent the entrance of gonococci from without. If the patient calls in the morning, he is advised to make an injection of the B. P. Z. solution [2] before his evening meal, and once more before going to bed, but not the next morning; he receives a second silver injection, in the forenoon, usually of a stronger concentration than on the first day, and also on the third day, the B. P. Z. injections being repeated as on the first day; on the fourth day only the astringent injections are repeated three times; on the fifth day follows a silver injection, then the B. P. Z. injections are continued for forty-eight hours; and on the eighth day, after twenty-four hours' omission of all treatment, another silver injection is made, usually of a less concentrated solution. Usually, the discharge ceases after the second or third day, or becomes so insignificant that it hardly furnishes a specimen for microscopical examination; the gonococci often disappear on the second or third day; nevertheless, I consider it advisable to continue the treatment to the eighth day.

If the patient does not come under observation until four or five days after the outbreak of symptoms . . . the silver injections are not made oftener than every third or fourth day, while astringent solutions are administered by the patient, sometimes combined with oil of santal and other

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[1] *N. Y. Med. Jour.*, November 21, 28, and December 5, 1903.

[2] ℞ Boric acid ..... 1.5 gm. (24 gr.);
Acetate of lead } ..... āā 75 cm. (12 gr.);
Sulphate of zinc }
Glycerin ..... 4 gm. (1 dm.);
Water ..... 120 gm. (4 oz.).

internal medicines. Under such circumstances milder solutions are usually retorted to (protargol, 1 to 2 per cent; albargin, 1 per cent; silver nitrate, $\frac{1}{8}$ to $\frac{1}{4}$ per cent) or thallin sulphate.

Finger employs 0.25 per cent protargol solutions, warm, and always precedes injection by a gentle irrigation with water to wash away the urine that remains in the canal. He insists that the injection syringe should contain at least 10 to 12 c.c. He retains the fluid at least five minutes and expects it to reach the posterior urethra. He injects three or four times a day. After three or four days he increases the strength of the protargol to 0.5 per cent, then to 2 per cent. Then, in the second week, he begins with largin, 0.25 per cent, and within two weeks increases the strength of this to 1 per cent, meanwhile diminishing the frequency of injection to once a day, substituting Ultzmann's astringent injection (p. 206) twice a day.

Permanganate Irrigation

Janet's Method.—Janet devised the permanganate method of irrigation treatment for acute urethral gonorrhea. He introduced neither the drug nor the method. But he combined the two in a practical system. His instruments are sold in this country under the name of Valentine, and his method is often incorrectly spoken of as Valentine's method. Janet irrigates the posterior urethra by gravity, without a catheter.

He irrigates the anterior urethra twice a day for three or four days, then increases the interval from twelve to eighteen hours. When the cloudiness of the first urine is pretty well gone, he makes the interval twenty-four hours. When the discharge is no longer purulent, he makes it forty-eight hours.

When the second urine becomes cloudy, he irrigates the posterior urethra according to the same method, twice a day at first, later every day or every other day. For each irrigation, of anterior or posterior urethra, he employs 500 c.c. of fluid, at a temperature of 110° F.

If the case is seen before the appearance of marked inflammatory symptoms, he employs a 1 : 500 solution of permanganate, immediately followed by a like quantity of boric-acid solution. If this does not prove too irritating, he continues at this strength until the inflammation has subsided sufficiently to permit intervals of thirty-six to forty-eight hours, when he drops to 1 : 4,000 or 1 : 6,000 permanganate and omits the boric acid.

If the posterior urethra becomes inflamed, he begins irrigating it with solutions of 1 : 4,000 down to 1 : 10,000. If these are well borne, he increases the strength to 1 : 2,000 or 1 : 1,000, and follows it with a boric-acid irrigation.

If the patient is first seen after the appearance of acute inflammatory

symptoms, the irrigation is begun at 1 : 10,000 to 1 : 4,000 strength, and only for the anterior, even if the posterior urethra is inflamed. He begins treatment of the posterior urethra only when the anterior inflammation is under control.

In the declining stage he gives a daily wash of 1 : 6,000 to 1 : 8,000.

Other Methods.—Valentine and the other followers of the Janet method in this country follow his method with certain variations. They usually employ much weaker solutions (1 : 4,000 to 1 : 20,000) and larger quantities (1,000 c.c. or more), and often irrigate the posterior urethra every day or every alternate day as a routine measure.

Results.—Janet claims a cure within three weeks for most cases seen early,[1] and Valentine says[2]: "No other method can show 90 per cent of cures in fourteen days." Yet the method which was almost universally tried ten years ago has now quite fallen into disrepute. I can add one more voice to those assembled in protest by Horwitz.[3]

I cannot even say that I have found it useful in conjunction with the silver salts, until the acute inflammation has been controlled. But in the terminal treatment it is our most valuable remedy.

THE TERMINAL (EXPECTANT) TREATMENT

The *terminal* and *expectant treatments* of acute urethral gonorrhea are not precisely the same thing. The expectant treatment consists in employing no local repressive measures, letting the disease run for three to four weeks until it begins to abate, and then applying local measures. Terminal treatment includes all measures applied during the stage of decline, whether the case has been through an expectant or a repressive course.

Terminal treatment, therefore, begins in the third to the fifth week of the disease in two classes of cases, viz.: those that have been controlled, but not cured, by repressive measures, and those that have begun to abate spontaneously.

Precisely when to begin terminal treatment in either event must depend upon the judgment of the physician, founded on his previous experience.

If the case has been treated expectantly, terminal treatment is begun according to the method used for repressive treatment. By this the symptoms are very promptly controlled, and within a week or so the case is usually ready for actual terminal measures.

Terminal treatment begins with examination of the prostate and vesicles, even if the second flow of urine is and always has been clear.

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[1] Cf. Monograph in Oberlaender, Chr., *Gonorrhoe d. Manul. Harmohre*, 1905.

[2] "The Irrigation Treatment of Gonorrhea," 1899.

[3] *Therap. Gaz.*, March, 1903.

The patient urinates to clear the anterior urethra of pus, but retaining a little urine in the bladder. The prostate and vesicles are then gently massaged, a small catheter gently introduced, and the first urine passing through this caught and examined for pus. If this is found (by microscope), the case is treated as one of prostatitis or vesiculitis (p. 200); if not, as one of urethritis. In any case, this examination is concluded by a bladder irrigation with 1:8,000 potassium permanganate.

Thereafter the patient continues to use anterior injections himself and returns to the physician for treatment of the posterior urethra.

Treatment of the Anterior Urethra.—The patient uses an injection twice, rarely thrice, a day. If the discharge contains gonococci, this injection should be antiseptic (usually protargol, 0.5 per cent); if not, astringent (zinc salts). Such is the general rule; yet it is always well to experiment with astringents, even in gonococcic cases. Order one astringent injection a day in addition to two antiseptic ones; if this diminishes the discharge or clears the urine, the astringent may replace the antiseptic still further. Indeed, it is not uncommon for gonococcic cases to do better on an exclusively astringent local treatment. Non-gonococcic cases, on the other hand, never do well on exclusively antiseptic treatment.

Treatment of the Posterior Urethra.—If the case is progressing satisfactorily to a cure under anterior injections, no treatment of the posterior urethra is required. But if there is a halt in this progress, as judged by the two-glass urinary test, or if prostatic massage reveals prostatitis, or if the second flow of urine is slightly purulent, treatment of the posterior urethra should be begun by posterior irrigations once a day or once every alternate day, combined with the treatment of prostatitis, if this is present.

The frequency and the nature of the irrigation varies according to the idiosyncrasies of each case. Permanganate in weak (1:6,000 or 1:8,000) solution is the most generally efficacious, silver nitrate and silver permanganate stand second. If irrigations irritate, instillations must be employed. If this treatment fails to cure in a few weeks, the case must be considered chronic and treated accordingly.

TREATMENT OF COMPLICATIONS

Abscess of the Urethral Glands.—Acute relapse or chronic prolongation of gonorrhea because of infection of the glands or of the paraurethral ducts is a matter for treatment in the chronic stages of the disease; nothing can be done while the whole urethra remains acutely inflamed.

Periurethritis.—Periurethritis occurring in acute gonorrhea need not interfere with repressive treatment.

All pus formations about the urethra, whether diffuse or circumscribed, are treated during the acute inflammatory stage on general surgical principles—by rest, protection from friction and injury, moist weak bichlorid or mild carbolized wet dressing under gutta-percha tissue. Incision should not be made too hastily nor until the formation of pus is pronounced, for resolution often occurs when suppuration seems inevitable. Ichthyol, pure or diluted, seems sometimes to favor resolution. When the abscess projects internally and not externally, an attempt should be made to open it from within through a urethroscope (p. 191), thereby averting threatened fistula; for the abscess cavity may be better treated afterwards from within than from without. When suppuration is under the skin a cutaneous incision is required, and frequently there will be no subsequent urinary leakage, and the abscess may be treated along ordinary surgical lines.

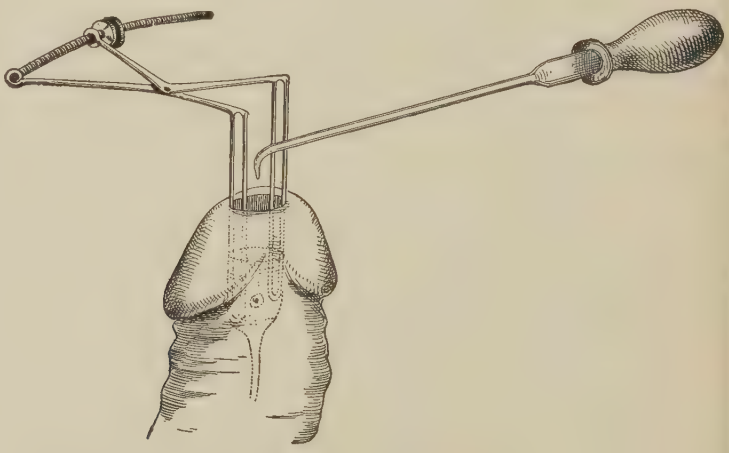

FIG. 51.—INJECTION OF URETHRAL FISTULA.

When permanent fistula results it should be treated by Chetwood's method, viz.: the injection into the urethra end of the fistula of a 25-per-cent ethereal solution of peroxid of hydrogen, using a fine-drawn, rubber-capped, glass pipette (Fig. 51) with bent extremity.

By means of this instrument, aided by a wire urethral speculum, a few drops of the solution are thrown into the abscess cavity to destroy the unhealthy granulations. This is repeated after three days, and then a milder solution (5 per cent) is injected every second day, until the fistula has closed. This treatment should be applied from within the urethra, the internal orifice of the fistula being enlarged for that purpose, if necessary. Fistulæ that do not yield to this treatment require a plastic operation.

If the case is more chronic from the start and the little shotlike or

pealike bodies remain under the skin, refusing to suppurate actively, these little tumors may be cut out through a cutaneous incision.

Spongeitis and Cavernitis.—*Chordee,* the commonest evidence of inflammation in the corpus spongiosum, is not a contra-indication to repressive treatment. Indeed, this often cures chordee, but if the erections are rendered more painful by the injections, these must be stopped. Chordee is self-limited. It usually ceases in ten days, always in twenty. To prevent chordee the patient should eat lightly in the evening, and avoid all sexual associations, sleep under light covers, and arise to urinate in the middle of the night. To palliate it he should bend the erect penis gently downward and check the erection by immediate urination, or by first plunging the penis into cold water and then urinating. Prostatic massage has been suggested as a means to reduce the sexual tension and so prevent erections. I have not found it of any service, though one occasionally sees an amorous patient in the declining stage of acute gonorrhea benefit by sexual intercourse.

The rare, true spongeitis or cavernitis is treated by rest and cold or heat, until resolution occurs or abscess requires incision.

Balanoposthitis, Lymphangitis.—These are treated in the usual way (pp. 684, 687).

Paraurethral Canals.—Inflamed paraurethral canals or pouches should be slit up as soon as they are recognized, unless the anterior urethra is acutely inflamed at the time (p. 241).

Acute Posterior Urethritis and Cystitis.—Under this head we consider the treatment of cases of posterior urethritis unaccompanied by palpable change in the prostate, and too severe to be controlled by routine treatment of the posterior urethra (p. 165).

In such cases all local treatment of the urethra must be abandoned. The patient is persuaded to rest as much as possible, in bed if the pain is very severe. Some bland sedative mixture, such as the liquor potassæ and tr. hyoscyami mixture, is administered. The bromids are usually the best sedatives; they may be added to the above mixture, though I prefer to give them separately.

To alleviate pain I usually advise the constant application of a hot-water bag to the perineum, and a sitz bath of five minutes in water as hot as can be borne, to be taken at least twice a day, or, if it gives great relief, before each micturition. Some patients prefer to urinate in the bath. Hot rectal douches, very gently administered, not oftener than twice a day may sometimes be substituted with advantage for a sitz bath, but they may irritate more than they soothe. Sedative suppositories of opium and other drugs are singularly inefficient. Such drugs are more effective and under better control if given by mouth.

If incessant pain continues or grows worse under this treatment, and the absence of fever or complete retention, or a prostate palpably in-

flamed, shows that there is no marked prostatitis, the inflammation may be directly attacked (after local anesthetization of the urethra) by instillation of very strong silver-nitrate solutions. The instillation should be administered with the utmost gentleness in the posterior urethra. An excellent way to give them is to fill a Keyes instillator with 2 per cent silver-nitrate solution, introduce it into the posterior urethra, unscrew the syringe without depressing the piston, replace it by one containing salt solution, depress the piston of this 10 minims (about the content of the instillator tube), wait half a minute or more, then push the piston home and gently withdraw the instrument.

By this maneuver the irritating effect of the silver is neutralized. If the patient is too nervous to stand so complex an operation, the silver may be given alone; but not more than 3 to 5 minims (0.2 to 0.3 c.c.) should be injected. The injection may be repeated in greater or less strength every two or three days. Twenty per cent gomenol is, I believe, not quite so efficacious as the silver salt.

The effect of the injection is often a marked diminution in the pain. As soon as this occurs local treatment is stopped until the symptoms have considerably ameliorated, when it is resumed as in the terminal treatment (p. 226).

If pain persists in spite of instillations, the case is treated as one of acute prostatitis.

Acute Prostatitis and Prostatic Abscess.—In Chapter XIV we have shown the futility of attempting to distinguish clinically between acute prostatitis and prostatic abscess.

The treatment of this condition is prophylactic, palliative, and operative.

Prophylactic Treatment.—The treatment of acute prostatitis, to be truly successful, should begin before there is any abscess, even before there is any prostatitis; it should be preventive. To prevent acute prostatitis the most important precaution, apart from gentleness in all urethral instrumentation, is a great respect for the urethra during acute gonorrhea. Prostatic abscess is nowadays more often caused by intemperate use of the so-called abortive treatment of gonorrhea, whether injection or irrigation, than by anything else. In only one acute gonorrheal case operated upon by me had the patient *not* been taking an "abortive" course, while of the four whose abscess was directly due to such a course three were married men upon whom argyrol (2) or permanganate (1) had been vigorously employed in the vain hope of curing the disease in a few days.

Palliative Treatment.—The palliative treatment is much the same as that of acute posterior urethritis.

If there is acute retention, a small (15 F.) soft-rubber catheter should be introduced three or four times a day until this is relieved, and

followed by a mild antiseptic irrigation, though if spontaneous urination is not established within a day or so, or if catheterism is difficult or painful (because of stricture or inflammation), one should operate at once.

To sum up, the palliative treatment consists of:

(1) Stopping all urethral treatment.

(2) The administration by mouth of some soothing urinary antiseptic with whatever sedative and laxative may be necessary.

(3) Insistence upon the general rules of antigonorrheic treatment, especially as to physical rest; rest in bed, if there is fever.

(4) Hot sitz baths or hot rectal douches, with the hot-water bag as local sedative.

(5) Catheterism and bladder wash if there is complete retention.

As a result of this treatment we look for prompt relief of two symptoms, viz., fever and retention.

If the patient's temperature does not within a few days fall to and remain below 100° F., and if acute complete retention is not almost immediately relieved, the abscess should be promptly operated upon.

Such a rule may seem unnecessarily severe, even brutally surgical, for it takes no account of the precise pathological conditions within the prostate. Yet it is fully as justifiable, fully as necessary, as the rule to operate early in acute appendicitis. In each disease unexpected cure without operation may follow a long and, in this instance, a peculiarly distressing illness. But such a cure is not to be compared with the immediate relief following upon operation, while the entire safety of such an operation, if promptly and properly performed, contrasts strikingly with the miserable and even fatal results of palliative treatment unwisely prolonged.[1]

Operative Treatment.—See p. 885.

Seminal Vesiculitis and Deferentitis.—The seminal vesicle very rarely requires treatment during acute urethral gonorrhea. Acute inflammation in it is rare and is habitually but a minor accompaniment to a more important acute prostatitis. The treatment is the palliative treatment of acute prostatitis.

When active suppuration occurs in or about the vesicle, this is usually not discovered until adhesion with the bowel has taken place. In this event the abscess should be incised from the rectum. But if suppuration tends to spread off into the ischiorectal fossa or threatens the peritoneum, it should be approached from the perineum.

Epididymitis.—See p. 618.

Cystitis.—The treatment of gonorrheal cystitis is that of acute posterior urethritis, as described above.

Pyelo-nephritis.—See p. 391.

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[1] Keyes, *N. Y. Polyclinic Med. Jour.*, 1908, Nos. 9 and 10.

CHAPTER XXI

TREATMENT OF CHRONIC URETHRITIS

The treatment of chronic urethritis is entirely empirical, like the treatment of chronic catarrh of any mucous membrane. So much depends upon the physical character of the patient himself, and so much upon the precise way in which local treatment is conducted, that it is impossible for any two men to treat the condition by precisely the same method. It is to be borne in mind that the milder forms of chronic urethritis tend to get well spontaneously under proper general and sexual hygiene. Even the cases that resist local treatment most effectively are not those that most seriously threaten the patient's health, but rather the minor catarrhs that are perfectly curable by hygienic methods; while the more severe inflammations, such as stricture of the anterior urethra and marked suppuration in the prostate and seminal vesicles, usually yield rapidly to intelligent local treatment. But it is impossible to decide beforehand precisely what treatment will suit a given case. The most anemic and neurotic patient may be cured by a few irrigations, while the most robust may show a slight catarrh that resists every local and general measure. It is of the first importance, therefore, that the patient's general and sexual hygiene be closely investigated, and every effort made from the outset to put him in the best possible circumstances for overcoming his local inflammation.

In the second place, it is important that whatever local treatment is undertaken should be given for the definite purpose of curing a known lesion. Yet this local treatment should be carried out in a purely tentative way, for, as has already been stated in speaking of diagnosis, it is impossible to decide beforehand which of the various lesions along the urethra is the important one, and it is equally impossible to be sure whether any form of local treatment will do good rather than harm until it has been tried. It is, therefore, necessary to conduct a given method of treatment with a close eye to results, and, unless some definite change for the better is promptly perceived by the physician, the method of treatment must be shifted. In making these shifts it is necessary every little while to take a breathing space—to stop all local treatment and give the urethra a few weeks' rest, controlling the discharge, if need be, by

an anterior astringent injection, or, preferably, not even using this, if the patient's confidence can be retained without it.

Bearing these general considerations in mind, we may proceed to detail the methods of treatment employed, beginning with those most commonly used and ending with the ones that are only required for exceptional cases.

GENERAL TREATMENT

General Hygiene.—Many of the general hygienic rules for the treatment of acute gonorrheal urethritis do not apply to the treatment of chronic inflammations. Thus the *diet,* which should be light during the acute period of the disease, should be rather full and stimulating in the chronic stages. *Exercise,* which is always harmful in acute gonorrhea, is often beneficial to a chronic case. Exercise should not only be permitted, but should be encouraged. There is no reason to prohibit even such violent pastimes as tennis, horseback riding, and swimming, to a patient suffering from chronic urethritis; *but they should be begun gently,* and the patient should feel his way, taking more and more exercise as he assures himself that it does him no harm.

The intelligent use of *alcohol* is one of the most thoroughly misunderstood points about the treatment of chronic urethritis. Although we realize that many of the drugs and methods of local treatment employed for chronic urethritis are used chiefly because they are irritating, yet we forget that alcohol is one of the best known urethral irritants, and we are too much inclined to scoff at the story of the patient who, despairing of a cure after many months of treatment for his local urethritis, breaks training, enters a wild debauch, and comes out of it cured. Such a case is not the exception that proves the rule, but is only an illustration of the rule that what we seek for the cure of chronic urethritis is the proper irritant, and alcohol sometimes fits the case. Alcohol is almost universally harmful so long as gonococci can be found in the urethral pus (though there are rare exceptions even to this rule); but after the gonococci have disappeared, if the patient is an habitual drinker, it is proper to urge him to return gradually to the use of alcohol, and such a course frequently has a most beneficial effect, both upon the patient's mind and upon his catarrh. It is an exhibition of intelligence on the part of the physician to cure his patient by giving him whisky to drink, and one should never run the risk of permitting the patient to make this experiment for himself.

Other hygienic measures, such as sending a patient away from the city to the country, or bidding him change his climatic conditions by a trip at sea or to the mountains, are very rarely called for. Yet, when local measures fail after a thorough trial, it is imperative that the pa-

tient leave his office and his home to take a vacation. Under such conditions a brief trip may well effect a cure, or at least put the patient in such a condition that local treatment, which previously was ineffective, will now prove curative.

Sexual Hygiene.—While gonococci persist sexual intercourse is as likely to reinfect the gonorrheic as it is to infect his partner. But after their disappearance it is likely to do good by relieving the sexual congestion of one who is (presumably) accustomed to frequent sexual intercourse. The irritation of ungratified sexual desire, the effort to check the sexual habit, is to many gonorrheics the most distressing feature of the disease.

Drugs.—Most cases of chronic urethritis may be treated successfully without any internal administration of drugs. Very exceptionally a patient is benefited by the internal administration of balsamics or alkalies. More commonly, a brief, severe course of water drinking will cure a mild catarrh by flushing the canal. The alkaline mineral waters are, apparently, the best suited for this purpose. Urotropin is employed as an antiseptic preliminary to the use of sounds or dilators, and for the treatment of pyelo-nephritis or bacteriuria. Alcohol should be used intelligently, as stated above.

INJECTIONS AND IRRIGATIONS

Unless there is some indication to the contrary, the first local treatment to be employed upon any patient with chronic urethritis is urethral injection or irrigation. It is, perhaps, a matter of taste whether to begin, as a routine measure, by bidding the patient to use injections for the anterior urethra or to return to his physician for irrigations of the posterior urethra. No fixed rule can be given. If the discharge is profuse, it is usually, but not necessarily, wise to begin with injections. If it is slight, irrigations may usually be depended upon alone. The patient's mental attitude, the frequency with which he is able to return for treatment, and the results of experimental treatment in each direction, must be the guide in a given case.

Injections.—The astringent injections are the most generally useful. My preference is for the zinc acetate mixture or the permanganate of zinc solution (p. 205). It is preferable not to employ them more than twice a day. They should be retained in the urethra only long enough to fill the canal. No effort should be made to prevent their reaching the deeper portions of the urethra, nor should they be forced back into the posterior canal.

If the discharge is profuse and contains gonococci, the organic silver salts, notably protargol, may prove more effective than the astringents; but the more chronic the case, the less likely are the silver salts to do

good. Whatever injection is employed may do good at first and irritate, later. Its use should, therefore, be intermitted every few weeks.

Irrigations.—Having completed the diagnosis in the manner described on p. 187, it is my custom to begin treatment by irrigating the bladder with permanganate of potash (1 : 4,000 every day or every other day). Even if the prostate is mildly involved, it is often better to neglect this for the time, until the surface inflammation is a trifle calmed by the irrigations.

If three or four irrigations do no good, a change may be made by increasing the strength of the solution, or by adding to each 500 c.c. ten drops of a 10 per cent silver-nitrate solution.

If the prostate and vesicles are markedly involved, massage upon them is begun early; if but slightly involved, it is begun after the first few irrigations and continued according to the rules given below.

At this time, also, infiltrations or strictures of large caliber in the anterior urethra are to be sought for (p. 189) if the case is not progressing satisfactorily.

The organic silver salts are sometimes more useful than the astringents when gonococci are present; and if the posterior urethritis is severe, instillations are to be employed at first, instead of irrigations, while if it is exceptionally mild, but the patient has many subjective, painful, or neurotic symptoms, instillations of nitrate of silver are usually most beneficial.

DILATATION AND MASSAGE

One of the most difficult problems in the treatment of chronic urethritis is the intelligent use of dilatation and massage. Theoretically, every sclerotic anterior urethra should be dilated until the sclerosis disappears and the surface of the mucous membrane appears healed when looked at through the urethroscope. Theoretically, every inflamed prostate and seminal vesicle should be massaged until it no longer yields pus. Practically, the most successful practitioners honor these rules more in the breach than in the observance. Many an anterior urethra becomes and remains apparently well, though it bears untreated scars. Many a prostate continues to excrete pus, in spite of all that can be done by the most vigorous and long-continued massage. Indeed, if one follows these cases as I have done,[1] treating them up to the point of clinical cure, then observing them, and massaging the prostate as part of the observation every few months for a year or more thereafter, one is surprised to note that a prostate, the treatment of which was stopped with some misgivings, will often show less pus in its secretion after several months than it

[1] Keyes's, *Jour. Am. Med. Assn.*, 1904, xliii, 187.

did while treatment was being pushed. If relapse is noted after the interval, especially if that relapse be only in the shape of an increased amount of pus in the secretion, without any subjective symptoms or urinary signs, a few rubs usually set things right again.

On the other hand, if dilatation is persisted in until the urethroscope shows a perfectly satisfactory condition of the mucous membrane, or if massage of the prostate and vesicles is persisted in, long after the disappearance of symptoms and urinary signs, in the hope of expressing a last pus corpuscle from these organs, the case is likely to be sadly overtreated. This is especially true in the matter of massage. From the prostate, the seat of severe or prolonged chronic inflammation, it is almost impossible to remove the last trace of pus; and it is almost certain that, after a thorough course of rubbing with this end in view, the prostatitis is quite as likely to relapse as though the patient had been more moderately treated, with a view to controlling and not eradicating the prostatic suppuration. Relapse, after such a course of treatment, is the making of a sexual neurasthenic.

The fear, so commonly expressed both by the profession and by the laity, that chronic prostatitis leads to prostatic hypertrophy is without clinical foundation. In the report already referred to I have shown that, among men of a given age, prostatic retention is less common if they have suffered from severe and prolonged prostatitis in their youth than it is among their more fortunate brethren who either deny gonorrhea absolutely, or, at most, have not had severe prostatic inflammatory complications from this disease. Were prostatitis so much to be dreaded as a cause of prostatic hypertrophy as some of our brethren maintain, given the fact that prostatitis is so common a complication of gonorrhea as these same brethren gladly admit, one might expect to see in the generation which has now passed its fiftieth year, and which went through its gonococcic period at a time when no finger invaded the prostatic penetralia, an overwhelming proportion of prostatics—many times more than the clinic actually shows.

Theory of Dilatation and Massage.—The important pathologic changes of chronic urethritis occur chiefly below the surface, in the glands of the anterior and the posterior urethra, and in sclerosis of the mucous membrane about these inflamed glands. The reason for employing dilatation of the anterior urethra and massage of the posterior urethra in the treatment of chronic urethritis is, therefore, twofold. First, in order to express the accumulated secretions from the glands and thereby to permit them mechanically to return to a more normal condition; and secondly, by making pressure upon the inflammatory tissue about these glands, and especially about their orifices, to encourage resorption of this exudate and to discourage its change into a permanent scar.

One might suppose, *a priori,* that every chronic urethritis, therefore, required either dilatation or massage, and more probably both, but such is far from being the case. Some inflamed urethras not only heal as well without these measures, but heal even better without them. Massage of the prostate and vesicles may prove irritating rather than beneficial, and the danger from irritation by the use of sounds and dilators in the urethra is well known. Moreover, the moderately inflamed anterior or posterior urethra gets well without mechanical pressure in many instances. Hence, it is well to reserve massage, and even more carefully to reserve dilatation, for those cases that really need it—that are not curable without it. One can scarcely be too enthusiastic about the advantages of these methods of treatment if one always bears in mind their dangers.

Technic of Dilatation.—If examination with the bulbous bougie reveals an induration in the anterior urethra, which is not promptly ameliorated or cured by irrigations, it should be dilated. If the patient's meatus is sufficiently large, the dilatation should be begun with sounds, and these should be carried to the limit of the meatus. The urethra should be dilated not more than three numbers at a given occasion, and the usual precautions of hexamethylenamin and irrigation should be employed. In urethritis, permanganate irrigation is usually preferable to silver-nitrate instillations.

When the first sound is passed, the urethra should be palpated upon it to discover any perceptible infiltrations or minute glandular indurations, and if these are found they should be gently massaged for a minute or more upon the sound each time it is introduced thereafter until they disappear, or until it becomes evident that they are permanent scars.

Sounding should be repeated twice a week, and when the limit of the meatus is reached, dilatation with the Kollmann dilator should be begun. In using the dilator it is often possible to advance much more rapidly than with the sound. The instrument is screwed up gently, one waits a moment, and then gently turns the wheel a trifle more. By thus turning intermittently, one gains two or three numbers with little pain to the patient and without exciting much bleeding.

I see no advantage in leaving sounds or dilators in the urethra for more than a few moments after the desired dilatation has been achieved.

It is a general rule that bleeding is a sign of too severe dilatation. Yet, if the surface of the urethra is much inflamed, the very introduction of the instrument may cause bleeding.

Contra-indications to Dilatation.—While gonococci persist in the urethra, dilatation is dangerous. It may do good; it is more likely to do harm. While the urine contains free pus, even though that pus show no gonococci, dilatation is still somewhat dangerous, and should be undertaken only after every effort to clear the urine of free pus has failed;

but when only a very light, purulent cloud remains, and the urine shows many shreds, dilatation is likely to be most serviceable and almost free from danger. Yet it is always possible that the dilatation may excite acute prostatitis or epididymitis. These may be avoided, to be sure, by restricting the dilatation to the anterior urethra. Yet, in some instances, the dilatation, to be efficient, must include the membranous urethra, since the bulb and the bulbo-membranous junction are likely to be the regions most in need of stretching.

The contra-indications to dilatation, by subjective sensations of the patient, may be overcome by the use of local anesthesia (p. 53).

Technic of Massage.—The method of reaching and examining the prostate and seminal vesicles with the finger introduced into the rectum has already been described. One often speaks of massaging the prostate; but it is prudent, in view of the fact that the vesicles may be inflamed even when they feel normal, always to begin massage with the vesicles and then to massage the prostate, no matter which of these organs feels the more diseased, though one should spend most of one's time on obviously diseased regions.

The question whether these organs should be massaged severely or gently cannot be decided academically. A physician who rubs so hard as to make many of his patients faint loses many a case that must be massaged before it can be cured; and, on the other hand, the physician who massages too gently fails to cure certain cases that require severe rubbing. The intelligent practitioner will rub gently at first and increase the severity of the manipulation up to the point of the patient's endurance, and with an eye to the results obtained. Severe massage may do physical harm by exciting acute prostatitis, vesiculitis, and epididymitis. Mild massage very rarely does this. No two physicians massage with precisely the same method or with precisely the same severity, as patients are quick to note.

A simple method is to begin upon one vesicle, and, reaching up as far toward its fundus as possible, to press upon it and then withdraw the finger in a zigzag way until one reaches the prostate. This maneuver is repeated half a dozen times and then the same treatment given to the opposite vesicle. If the vesicles are impalpable, this is enough. If distended or indurated, the maneuver should be repeated often enough to make a distinct reduction in their size, if the patient can bear so much manipulation.

The finger is then brought down to the prostate. Hard, angular indurations in and about this organ had best be avoided, and pressure made chiefly upon the more yielding portions of the gland. Beginning with one lobe, pressure is made upon it either with a to-and-fro lateral sweep of the finger or with a circular motion. This manipulation, if gentle, may be continued for one minute; if severe, half a dozen strokes

may suffice. The same treatment is given the opposite lobe of the gland, and the manipulation concluded by a half dozen strokes over the prostatic sinus for the purpose of emptying the main ducts into the urethra.

Meanwhile, watch is kept for the expulsion of pus from the meatus, and this is caught upon a slide for examination.

Massage should usually be repeated not oftener than two or three times a week. If severe, longer intervals are better. In exceptional cases, when the return from massage is very great, gentle rubbing may be employed once a day. Massage should be continued until the subjective symptoms are relieved, and the return from the rubbing very slight and not densely purulent. If the return to normal is rapid, one may continue to rub until all pus disappears. The success of treatment must almost always be verified by three or four observations at intervals of one to three months. If pus has reaccumulated during these intervals, a few rubs will get rid of it.

Contra-indications to Massage.—Massage is dangerous only in the presence of acute inflammation of the urethra, the prostate, the vesicle, or the epididymis; but massage is harmful in case it increases the patient's subjective symptoms instead of relieving them. It is also harmful in case it so hypnotizes the patient that he thinks he must come for the rest of his natural days to be rubbed for the relief of imaginary discomforts. Such patients should be discouraged from massage by all possible means. Their proper cure is sexual relief by matrimony.

THE RECTAL DOUCHE

The rectal douche is an accessory or substitute to massage of the prostate and vesicles. The usual case, that can perfectly well submit to massage, need not bother with douches. But if the patient cannot reach his physician often enough for massage, if the inflammation is too acute for massage, or if massage proves irritating or in any way harmful, the rectal douche should be employed. The object of the rectal douche is to apply heat or cold to the prostate or vesicles. For this purpose, the closed tube, or psychrophore, may be employed, but the open double-current tube is better. Hot water is usually preferable to cold. The mechanism and technic have already been described. The injection should be repeated every day, with an interval of a few days, every two or three weeks, to make sure that the bowel is not being irritated. Some patients note an immediate sense of relief from the use of the rectal douche, but the majority do not, and it is often difficult to persuade a patient to go on, week after week, using a treatment which is a great nuisance and which does not appear to him beneficial. Yet the rectal douche is one of the few forms of treatment that I consider it wise to

continue for months at a time, with only such intervals as are necessary to insure the safety of the bowel.

OPERATIVE TREATMENT

In the absence of complications specifically requiring operations, such as intractable stricture, or abscess of the prostate or vesicle, it is, generally speaking, unwise to operate upon cases of chronic urethritis. Intractable cases of prostatic neuralgia have been cured by scraping the posterior urethra, but such a treatment would seem more likely to do harm than good in most cases. Young [1] advises prostatectomy for the treatment of chronic prostatitis; but his best results are obtained in cases of retention, and it is obvious that retention from prostatic bar or contracture in a young man requires the same operative treatment for its cure as does prostatic retention in the aged. Dilatation does these cases no good (p. 327).

Ligation of the vas deferens sometimes exercises a markedly beneficial effect upon severe, persistent prostatitis and vesiculitis, but since this operation renders the patient sterile it is permissible only upon old men and upon such young men as suffer from relapsing epididymitis incurable by any other means.

URETHROSCOPIC TREATMENT

The anterior urethra should be examined with the urethroscope, either at the time that dilatation seems indicated or at the time that it fails to do good. Urethroscopic treatment is very rarely necessary, although the German school prefer to use the urethroscope throughout. If urethroscopic observations are made throughout the course of treatment, the disappearance of infiltrations and the return of the mucous membrane to normal, or the final scarring of the urethra may be noted. But frequent introductions of the urethroscope are often more irritating than the dilatations themselves, and it does not seem necessary to watch the urethral mucous membrane when the progress of the cure can be observed quite as accurately by watching the disappearance of shreds and pus from the urine.

The methods of urethroscopic treatment are four:

Applications of chemicals to the mucous membrane.
Treatment of suppurating follicles or paraurethral canals.
Treatment of the verumontanum (p. 243).
Treatment of urethral neoplasms (p. 562).

Topical Applications.—If anterior urethritis resists treatment by the ordinary injection and dilatation, the urethroscope usually re-

[1] Johns Hopkins Hospital Report, vol. xiii.

veals localized areas of infiltration, in the midst of which are seen inflamed glands which may or may not exude pus. Applications to these spots may be made through the urethroscope by means of a cotton tampon on a wooden applicator. Nitrate of silver in 5 per cent to 20 per cent strength is the drug most commonly used. Sulphate of copper may be used in the same strength, or equal parts of iodin and carbolic acid may be employed. The applications are made precisely to the inflamed spot, after it has been touched with a dry piece of cotton, in order to rid it of secretions. No excess of the solution should be permitted to run over healthy parts of the mucous membrane. The treatment may be repeated not oftener than twice nor less often than once a week.

Treatment of Suppurating Follicles and Paraurethral Ducts.— Intractable anterior urethritis is sometimes due to persistent suppuration in one or more of the urethral follicles; most exceptionally, it is due to suppuration in a paraurethral canal. Various means of attacking such conditions through the urethroscope have been suggested. For the paraurethral canal, the best treatment is injection with 1 per cent nitrate of silver, and if this fails to cure after two or three injections, the canal should be split from end to end by means of a urethroscopic knife (Janet's trajectotome is the most convenient instrument). After the canal has thus been thrown open into the urethra, its inflammation is readily healed by the routine injections and dilatation. But after the operation no dilatation should be employed until gonococci have disappeared.

Suppurating follicles are best treated by destroying them with a galvano-caustic needle, which is plunged into the suppurating focus. The treatment of these lesions by injection with the urethral pipette, or by the application upon their surface of strong solutions, is not so rapidly successful. Churchman [1] thinks this method the best for paraurethritis, since he fears systemic infection from cutting.

TREATMENT OF POSTGONORRHEAL NEUROSES

The neuroses due to chronic prostatitis and seminal vesiculitis may or may not be postgonorrheal, as has already been suggested. Yet they usually follow gonorrhea, are usually attributed to it by the patient, and are, therefore, best considered under this aspect. They may be divided into three groups:

Sexual neuroses.
Painful neuroses.
Sexual neurasthenia.

[1] *Jour. Am. Med. Assn.*, January 14, 1905.

To these may be added, for the sake of convenience:

Prostatorrhea.

Spermatorrhea.

In order properly to treat these various conditions, an accurate diagnosis is necessary as to the presence or absence of the gonococcus, the gravity of the prostatitis or vesiculitis, the presence of urethral stricture or residual urine, of urethral hyperesthesia, and, above all, the neurotic caliber of the individual.

If gonococci are present, one must first get rid of these by appropriate measures. If the prostate and vesicles are markedly inflamed, these must be massaged until the amount of pus expressed is reduced to a minimum. If there is stricture, this must be dilated; if there is residual urine without any marked pathological cause, this may be set down to the sclerosis of the prostatic glands about the bladder neck, and is best treated by incision with the galvano-cautery (p. 327). If the urethra is hyperesthetic, this oversensitiveness must be dulled by the gentle passage of sounds as large as the patient can bear, each passage of the sound being preceded, if necessary, by an injection of alypin. At the same time, the condition of the verumontanum must be studied through the posterior urethroscope. If examination reveals that this is congested, swollen, or eroded, treatment must be directed to it. Throughout the treatment close watch must be kept upon its effect on the patient, and frequent questionings should elicit the precise nature of the patient's pain (if he has any).

It will usually be found that the proper treatment for pain is the treatment which strikes the painful spot. Thus, if pressure upon the prostate or upon the vesicle excites a discomfort which the patient recognizes as that from which he suffers, massage of these organs will relieve this discomfort; if the passage of a sound strikes the painful spot, sounds and irrigation are likely to cure; if touching the verumontanum with a swab introduced through the posterior urethroscope excites the pain, this is likely to prove the proper point of attack. In these cases above all others, care should be taken not to persist too long in any one course of treatment with blind insistence that this treatment must cure. Unless the progress of the case is entirely satisfactory, no given course of treatment should be persisted in for more than three weeks.

Finally, so many of these difficulties depend entirely upon sexual irregularities and derangements that the patient's sexual habits, both previous and present, should be intimately investigated, and every effort made to lead him to as clean, as wholesome, and as normal a sexual condition as it is possible for him to attain. Although matrimony cannot be prescribed like a pill, and although these patients are often sorry subjects to place on any woman's hands, truly happy married life is often the only real remedy for the patient's condition, and,

unfortunately, almost as often it is a remedy beyond the patient's means.

Many special methods of treatment are employed upon these cases, especially for the purpose of improving defects in the sexual function. Such are: the administration of strychnin, damiana, and belladonna, the application of the galvanic or the high-frequency current to the prostate, either by means of a urethral electrode or by a rectal electrode, the more diffuse application of electricity in the form of high-frequency currents, the so-called violent ray, the high candle-power light, etc. Vibratory massage of the prostate through the rectum is also employed.

I have tried most of these measures and, though I have succeeded in curing certain cases, or at least in temporarily improving them, by almost every one of these means, they all fail in the majority of instances. Many years ago, by means of vibratory prostatic massage, I relieved a condition of deep urethral pain which had resisted every other form of treatment at my hands and at the hands of many practitioners. Quite recently I succeeded with the high-frequency current in markedly ameliorating the functional impotence and frequent nocturnal emissions of a patient who had traveled the length of the country in the vain hope of relief. Yet these cases are absolutely isolated. How much my personal suggestion had to do with these cures I hesitate to decide. In obscure cases, rebellious to all other methods of treatment, applications to the verumontanum through the posterior urethroscope have proven quite generally useful.

The technic of the application is as follows:

The urethroscope is introduced until its window is believed to be opposite the verumontanum. Its obturator is then removed and the verumontanum sought for by gently moving the urethroscope forward or back. If the lumen of the tube fills with blood or urine, this is mopped out by cotton swabs. When the verumontanum is plainly seen, it is very gently mopped dry with the swab and then touched with 10 per cent nitrate of silver upon a very minute cotton swab—so minute that none of the solution will be squeezed out over the surrounding parts. The thoroughness of the cauterization is controlled by visual examination. The tube is then withdrawn and the application not repeated within eight or ten days.

The solutions I have employed are 5, 10, and 20 per cent silver nitrate and the liquor hydrargyri nitratis.

It is said that curettage of the verumontanum through the urethroscope is sometimes of material assistance when cauterization fails. I have not employed it. Even the cauterization is quite a severe method of treatment, and if some benefit is not derived from the first two or three applications it should not be continued.

To sum up:

Sexual Neuroses. —In the treatment of sexual neuroses, regulation of the patient's sexual life is of the first importance. For deficient erection and premature ejaculation, more may usually be done by urethroscopic cauterization of the verumontanium than by any other local treatment. But massage of the dilated prostate or vesicles may help.

Painful Neuroses.—The sexual element is still of the greatest importance, and the decision as to what form of local treatment should be employed rests with the discovery of that form of treatment which touches the painful spot.

Sexual Neurasthenia.—The element of suggestion is here of the greatest importance. Sexual and general hygiene often succeed better without local treatment than with, and the effect of local treatment is chiefly suggestive.

Prostatorrhea and Spermatorrhea.—The leaky glands are emptied by massage and dilatation; but, inasmuch as the effect of local treatment is only temporary, the patient should be made to understand clearly that his condition is of no importance and will be likely to continue so long as he remains single.

CHAPTER XXII

SPASMODIC AND CONGENITAL STRICTURE

An abnormal narrowness of any portion of the canal of the urethra constitutes stricture, or, since the urethra is naturally a closed canal, Sir Charles Bell's definition may be more accurate and loss of dilatability may be termed stricture. This contraction of the canal, according to the first definition, to constitute stricture must be unnatural, for the urethra has certain points of normal contraction—namely, the meatus, the middle of the pendulous, and the beginning of the membranous urethra, and these are not strictures. They become so, however, if unduly small. Thus, an individual with an average-sized penis and urethra, whose meatus will only take a No. 10 French, has stricture (congenital) of the meatus, although he may never suffer any inconvenience therefrom. Again, any inflammatory condition of the walls of the canal, or spasmodic contraction of the same, constitutes stricture in a certain sense, as does also any growth upon or beneath the mucous membrane—cancerous, tubercular, syphilitic, or membranous. In the same way a collection of fluid outside the canal may constitute stricture—abscess, serous, or hydatid cyst, etc.—anything, in short, which lessens the size of the canal when distended by the stream of urine, foreign bodies, of course, excepted. In all the last-named conditions, however, stricture is only an epiphenomenon, and not the disease itself.

True stricture is of two kinds: 1. Muscular or spasmodic. 2. Permanent or organic—the latter congenital or acquired. Inflammatory stricture does not exist as a disease of the urethra. Any inflammation lessens the caliber of the canal in proportion to the turgescence of the mucous membrane; but no amount of simple inflammation of the urethral mucous membrane constricts the canal enough to occasion serious retention, unless occurring in connection with organic or spasmodic stricture, assisted by muscular spasm or complicated by congestion.

Obstruction of the urethra by stone, slough, or foreign body does not constitute stricture.

MUSCULAR OR SPASMODIC STRICTURE

Spasmodic stricture is an involuntary contraction of the compressor urethræ muscle of sufficient force to impede or to prevent, temporarily

or permanently, the passage of urine from the bladder. I have encountered no case of spasm of the pendulous urethra, though De Bovis [1] records two cases. The so-called spasm of an organic stricture is elastic or congestive, except when it occurs in the compressor muscle.

Spasmodic stricture is a symptom, not a disease. It always depends upon some separate and distinct condition. It varies with the variations of this etiological factor and disappears with its cure.

An active predisposing cause is a sensitive, high-strung nervous organization, often in connection with an irritable, a gouty, or a rheumatic constitution, and particularly in those who are sexually astray. Such a one is unable to urinate in the presence of his fellows, and the more anxious he is to pass his water, and the more water there is to pass, the more difficult does he find it to satisfy his desire. Certain mental suggestions contribute to increase or to diminish the spasm. The sound of running water often breaks the spell, while derision or absolute silence has the opposite effect. I have known a commercial traveler who, during twenty years of life spent mostly on the road, could not urinate in a railroad car except by means of a catheter. Yet such a man may well go through life with no great inconvenience from his urethral idiosyncrasy, his *urethrismus,* as Otis termed it. But let him acquire an organic stricture of a vesical calculus, let him be operated upon for hemorrhoids, or suffer any local or constitutional strain or shock, and his urination immediately becomes difficult or impossible to accomplish for a greater or less space of time. I have known an operation for hemorrhoids to occasion complete retention lasting ten days, long after the patient was up and about. Such a spasm, if unrelieved by catheterization, may even cause rupture of the bladder. Thus there is this much in the theory of Otis that an abnormally small meatus may cause urethrismus, that if the meatus is small enough to irritate the urethra by impeding urination, it may excite a spasmodic stricture, though I have never known it to do so.[2]

Symptoms and Diagnosis.—The one symptom of spasmodic stricture is inability to urinate. Hence, it is sometimes confounded with organic stricture. Indeed, not a few cases of stricture deemed impassable, when put upon the operating table have been found to admit a full-sized sound, being cases of spasm with little or no organic contracture. The following differentiating points are therefore memorable:

1. Spasmodic stricture occurs only in the membranous urethra.

2. Unless there is some organic lesion of the urinary tract the urine is bright and sparkling, which it very rarely is if there is organic stricture sufficiently marked to seriously arrest urination.

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[1] *Gaz. des hôp.*, 1897, LXX, 583.

[2] *Jour. of Cut. and Gen.-Urin. Dis.*, 1887, v, 2.

3. Although it may be impossible to introduce a filiform bougie or a small sound, a full-sized sound, if allowed to rest for a few moments against the face of the stricture, will usually tire the muscle, and finally slip into the bladder. If it slips in by its own weight its course will often be jerky and irregular, as the muscle gives way by succeeding spasms of lessening intensity.

4. When the instrument is once introduced the obstacle is wiped out, and the withdrawal of the instrument is not opposed by any such grasping as is felt when there is tight organic stricture.[1]

5. Even though a spasmodic stricture be absolutely impassable, general anesthesia will entirely relax it and permit the passage of any instrument that the normal canal will take.

6. Organic and spasmodic stricture often coexist.[2] Indeed, organic stricture is the most common cause of spasm, and spasm may be the notable symptom of an organic stricture of large caliber.

Treatment.—The retention may be relieved by a hot sitz bath or by catheterization.

The tendency to spasm is overcome by removing the cause and improving the general hygiene, special attention being paid to sexual irregularities, concentrated urine, and organic stricture.

To prevent recurrence of the spasm I know nothing better than the passage of a full-sized steel sound to overstretch the muscle, and silver-nitrate instillations to blunt the sensibility of the deep urethra.

CONGENITAL STRICTURE

Congenital stricture or occlusion of the urethra may occur at three places in the urethra:

1. At the meatus.
2. At the outer limit of the fossa navicularis, and
3. At the membranous urethra.

Such strictures are caused by inaccurate apposition in the embryo of separately developed sections of the urethra. Stricture in the deep urethra is most unusual. Guibé relates an interesting fatal case in which the stricture only admitted a needle. On the other hand, congenital stricture at the meatus, or at the outer end of the fossa navicularis (aptly termed the second meatus) is very common. Indeed, the size of the meatus is no more fixed than the size of the mouth or the nose, though, in general, a small penis is far more likely to have a contracted meatus than is a large one. Moreover, the second meatus is rarely

[1] But if the instrument passed is a small one (less than 24 F.) it does not overstretch the muscle and may therefore be grasped on withdrawal.

[2] Indeed, continued spasm may doubtless cause ulceration, just as spasm of the bowel causes fissure in ano. (Cf. Keyes, *Am. Jour. of Urology*, 1905, i, 218.)

smaller than the first, hence congenital stricture need not be looked for here unless congenital stricture of the meatus externus is seen to exist.

The solution of the question, how much contraction constitutes stricture of the meatus, depends upon one's point of view. Strictly speaking, a meatus is strictured if a probe, introduced into the fossa navicularis and rotated so as to sweep the point outward along the floor of the urethra, encounters a thin membrane which it must surmount in coming out through the meatus. This obstruction always occurs on the floor of the canal, and is never anything more than a fold of mucous membrane that may be pushed out by the probe (Fig. 52). The second meatus is strictured if it is not so large as the normal true meatus.

Fig. 52.—Congenital Stricture of the Meatus. A probe is inserted into the pocket behind the stricture.

Strictly speaking, the above rule holds good. Practically, however, stricture of the meatus—to which so many reflex ills were once attributed—rarely produces any symptoms. If actually so small as to interfere with urination it may, perhaps, like a tight prepuce, cause hernia or even epilepsy in a child, and spasmodic stricture in later life, and the urethra may become considerably dilated behind it. But such cases are exceptional. Most men can go through life in blissful ignorance of the size of their meati unless they fall foul of the genito-urinary surgeon, who, to permit the passage of his sounds, may justly enlarge an orifice that had otherwise been sufficient for Nature's claims.

Complications.—Apart from the reflex irritation alluded to above, congenital stricture may, in exceptional instances, cause any of the phenomena of retention that may result from organic stricture. Yet a man may live many years without any evil effects from a meatus too small to admit a 10 F. bougie. In exceptional instances a pouch develops behind the obstruction.

Treatment.—The only way to cure a stricture of the meatus is to cut it. As above remarked, this is, as a rule, quite unnecessary, except for the surgeon's purposes.

The operation of *meatotomy* has occasioned the invention of various more or less ingenious *meatotomes,* of which the best is a blunt-pointed straight bistoury. This is the only instrument required, and the operation may be very elegantly performed as follows: After cleansing the parts with soap, bichlorid, and alcohol, a $\frac{1}{16}$ grain cocain tablet is inserted within the meatus and pressed into the little pocket below it. This is dissolved by dropping upon it two drops of 1:1,000 adrenalin solution. In a few moments the tip of the meatus is seen to blanch. The bistoury is then inserted and the membrane deliberately divided upon a

finger placed beneath the frenum, which appreciates the fibrous ring about the meatus and at the second meatus, and by feeling the blade of the bistoury beneath the skin recognizes when they have been effectually divided. The passage of a bulbous bougie proves that the obstructions have been sufficiently cut. If this technic is observed there will be no pain and little bleeding. The meatus is flushed clean and packed with cotton upon which glutol has been thickly dusted. This substance combines hemostatic and antiseptic properties. The glutol cotton is removed at the first act of urination, and the wound is kept open by inserting the curve of a clean hairpin into the urethra once a day. The hemorrhage may be profuse if no hemostatic applications are made, but there are no other complications, and in the most extreme cases lateral pressure will check the flow of blood.

CHAPTER XXIII

ORGANIC STRICTURE OF THE URETHRA—ETIOLOGY, PATHOLOGY, SYMPTOMS, RESULTS, DIAGNOSIS

Although two conditions commonly known as stricture have been described in the preceding chapter, the one, spasmodic stricture, is a mere symptom, and the other, congenital stricture, a condition which, except in extreme cases, is absolutely innocuous. True stricture, the stricture that is never innocuous and always active in its work of undermining its possessor's health, except when kept at bay by the surgeon's efforts, has yet to be considered.

True organic stricture of the urethra is a cicatrix of the urethral wall left there by some injury or inflammation, and manifesting a constant tendency to contract, and thus to diminish the lumen of the urethra. This tendency to contraction, which is always manifested in a greater or less degree, is doubtless caused by the irritation incident to micturition, the impact of the stream against the barrier; for the deepest stricture, the one that most obstructs the flow of urine, is almost always the tightest, and if the stricture is kept dilated so as to afford little or no obstruction, the tendency to recontraction is very slight.

VARIETIES

Strictures may be classified from several points of view: thus, for prognostic purposes, strictures are considered as anterior (at or in front of the penoscrotal angle) and posterior (behind this point); therapeutically considered, strictures are of large caliber (admitting a 24 F. bulbous bougie) or of small caliber; while from a pathological and etiological point of view strictures are classified as gonorrheal and traumatic. The old descriptive division into linear, annular, and tortuous or irregular stricture is clinically convenient to describe the nature of the obstruction to the exploring instrument, and the terms soft, fibrous, and inodular (or indurated) are descriptive of important features.

ETIOLOGY

All true strictures are either inflammatory or traumatic, and almost all inflammatory strictures are gonorrheal. An excessively severe or

prolonged simple urethritis may cause stricture, and so may urethral chancres, ulcers, neoplasms, and loss of substance following periurethritis. But these causes appear so rarely as to be quite negligible.[1]

By far the greater number of strictures are gonorrheal. Thus out of 220 cases studied by Thompson, 164 (75 per cent) owed their origin to gonorrhea; while Martin found among 219 cases 187 gonorrheal strictures (85 per cent).

The *causes of gonorrheal stricture* are, however, many. The inflammation itself usually causes the stricture; but it is difficult to estimate what proportion of strictures is due to breaking a chordee, to a false motion in coitus causing a tear in the inflamed mucous membrane, to the ill-advised use of caustic injections for the purpose of aborting the attack, or to the injudicious use of instruments in the urethra before the attack has subsided. Such strictures are properly traumatic, since trauma of the same kind, but greater in degree, may cause stricture when the mucous membrane is not inflamed and the gonorrhea thus only plays the rôle of a predisposing cause.

There is a small class of *intermediate cases* in which the stricture is neither absolutely inflammatory nor traumatic. To this class belong strictures caused by urethral chancres and ulcerations, or loss of substance from periurethritis, etc.

The *causes of traumatic stricture* vary widely. The *penile* portion of the urethra may be divided by knife or bullet, or torn by bending the erect penis, by a false motion in coitus, or by breaking a chordee. The *bulb* is the portion usually affected by trauma from within, by ulceration from stone, foreign body, or retained catheter, or by the sharp point of a blundering instrument. The *prostatic* urethra is said to become strictured when torn by disruption of the pelvis.

But of all traumatic strictures, recognizable as such, stricture of the *membranous urethra* or at the bulbo-membranous junction is the most frequent. The stricture is caused by a crushing force applied to the perineum, which brings the urethra sharply into contact with the subpubic ligament, crushing it beneath the sharp edge of this structure or tearing away from it in front.

The injuries which have caused traumatic stricture in the perineum, with or without a penetrating wound, are innumerable. Among the most classic may be mentioned falls from a height astraddle a beam, a chair, a stump, a manger, the limb of a tree, the corner of any blunt object, such as a trunk, a box, etc.; falls astraddle a fence while walking upon it, of a wheel while mounting an omnibus, of the tongue of a wagon; falls upon a sharp object, as a chisel, the breakage of a chamber-

[1] Ten cases of diffuse urethral syphiloma have been reported. *Guyon's Annales*, 1898, xvi, 892.

pot upon which the patient is sitting; falls with one leg through a hole in the ice, or down a coal hole in the sidewalk; being thrown forward upon the pommel of a saddle, while riding; fracture of the pelvis, kicks in the perineum from man or beast, etc., *ad infinitum*. This perhaps unnecessarily minute detail of injuries capable of causing stricture is given because they are all occurring constantly. They may be overlooked by the patient if they do not give rise to immediate hemorrhage or retention. The injury is then slight, not causing much immediate disturbance, and the patient forgets it; he never has a gonorrhea, perhaps, and yet in after years symptoms of stricture come on, and the canal is found tightly contracted at its membranous portion; or, in trying to relieve retention in fever, the physician finds his catheter unexpectedly arrested.

Pathogenesis.—The most notable modern theories upon the formation of stricture are the theory of Finger and the Guyon school, and the theory of Guiard.

The Finger-Guyon theory [1] makes stricture the result of chronic urethritis. According to these authors, chronic urethritis is essentially a sclerotic process, characterized by deposits of cicatricial tissue in the submucosa and even in the corpus spongiosum. This fact is illustrated by numerous pathological findings that would prove its truth were it not contradicted by the notorious clinical facts.

For although, as we have seen, acute urethritis is an exudative process that does tend to pass into a chronic sclerotic stage, the essential cause of the exudation is the acuteness of the attack and the extent of exudation, and subsequent cicatrization is proportional rather to the acuteness of the attack than to its duration. Hence, although stricture is always accompanied by chronic anterior urethritis, chronic anterior urethritis may exist for years without inducing stricture.

We therefore accept Guiard's theory,[2] that stricture depends upon the virulence of the urethral inflammation. The more severe the initial attack, the more intense the chordee, the more frequent and violent the relapses, and the longer the gonococcus can be found in the discharge, the greater is the probability of stricture. He believes that in a mild chronic stage the urethral inflammation is neither deep-seated nor productive of any permanent lesion; while the acute inflammation, with its involvement of the lacunæ and glands, its circumscribed or diffused areas of periurethritis, is the inflammation calculated to leave behind permanent scars in and beneath the mucous membrane.

In the etiology of *traumatic stricture* urinary infiltration must al-

[1] Finger, *Internat. klin. Rundschau*, February 12, 1893. Wassermann and Hallé, *Guyon's Annales*, 1891, ix, 143 *et passim*. Wassermann and Hallé, *Ibid.*, 1894, xii, 244, 321.

[2] "Les uréthrites chroniques chez l'homme." Paris, 1898, p. 90 *et seq.*

ways play some part. It is true a severe contusion and laceration of the urethral wall are ample causes for stricture; but it is incredible that the muscular disturbance of urination and the distention of the wound with a fluid containing urinary salts and urethral bacteria should cause no increase in the inflammatory reaction. The admirable results obtained by simple perineal section and diversion of the stream of urine from the wound confirm this belief.

In this connection *the time of occurrence of stricture after gonorrhea and injury* is of interest. Of the 164 cases of stricture following gonorrhea, tabulated by Thompson, in 10 symptoms appeared immediately after or during the attack; 71 within one year; 41 between three and four years; 22 between seven and eight years; 20 between eight and twenty-five years. Hill[1] makes the length of the period between the cause and the first symptoms of stricture noticed: after gonorrhea, shortest period two years, longest thirteen years; after urethral chancre, shortest period ten months, longest three years; after injury, shortest period four months, longest eighteen months. Guyon, among 142 cases of gonorrheal stricture, found only 4 cases within the first year, 10 during the second year, 79 distributed between the second and tenth years, and 49 after the tenth year. On the other hand, I have seen an impassable stricture in the perineum six weeks after a severe injury, and Guyon[2] has met a stricture which only admitted a 16 F. sound two weeks after injury, and another which would not admit a 12 F. after six weeks.

The deductions from the above statistics, confirmed by daily observation, are that the symptoms of stricture appear earlier after traumatism than after gonorrhea, the date of their appearance being measurably proportionate to the extent of the injury, and that the greatest divergence is noticeable after gonorrhea. It is totally exceptional, however, for symptoms of organic stricture to come on immediately after or during the attack of gonorrhea—as Thompson states occurred in ten of his cases—unless stricture existed previous to the attack, unnoticed by the patient.

PATHOLOGY

Number of Strictures.—While Thompson,[3] in examining 270 pathological specimens, found only 44 cases of multiple stricture, Guyon[4] lays down the clinical rule that gonorrheal strictures are multiple, while traumatic strictures are single. These statements, properly interpreted,

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[1] "An Analysis of One Hundred and Forty Cases of Stricture of the Urethra." London, 1871.

[2] "Leçons cliniques," 1894, vol. i, p. 239.

[3] "Stricture of the Urethra." Second edition, 1858, p. 76.

[4] *Op. cit.*, I, 139.

conform perfectly with each other and with the facts. Concerning traumatic strictures, there is no doubt; they are almost always single. But gonorrheal strictures, while frequently single from the pathologist's point of view, often present a number of ridges to the examining sound. Clinically, therefore, gonorrheal strictures are often multiple, pathologically they are usually single.

Seat of Stricture.—Upon this subject the laborious investigations of Thompson, upon the 270 specimens above referred to, must be considered final, especially as daily experience with patients bears out the truth of his conclusions. He divides the urethra into three regions:

1. The bulbo-membranous, including 1 inch in front of and $\frac{3}{4}$ inch behind the junction of the spongy with the membranous urethra.

2. From the anterior limit of region 1, to within $2\frac{1}{2}$ inches of the meatus, embracing from $2\frac{1}{2}$ to 3 inches of the spongy urethra.

3. The first $2\frac{1}{2}$ inches of the canal from the meatus.

The 270 preparations showed 320 strictures.

Region	1	contained	215	strictures—	67	per	cent.
"	2	"	51	"	16	"	
"	3	"	54	"	17	"	

There	were	185	cases	of	one	stricture	only,	situated	in region 1.
"	"	17	"	"	"	"	"	"	2.
"	"	24	"	"	"	"	"	"	3.

Otis placed a majority of all strictures within the first $1\frac{1}{4}$ inches from the meatus—the next most common position being somewhere in the middle portion of the pendulous urethra. He believed deep urethral stricture to be far less common; but these views, which Otis labored earnestly to advance for many years, were largely influenced by his theory that the urethra is a tube evenly calibrated throughout, and therefore what most other authors believe to be points of physiological narrowing (perhaps exaggerated in individual instances) of the normal healthy urethra, he denominated stricture.

It is convenient to associate the region in which the stricture occurs with its cause. Thus, strictures at or near the meatus, if not congenital, are usually caused by chancrous or chancroidal ulceration, less frequently by caustic injections and by gonorrhea. Strictures of the pendulous urethra are commonly gonorrheal. Strictures in the bulb and at the bulbo-membranous urethra are also commonly gonorrheal. Strictures of the membranous urethra are rarely gonorrheal, almost always traumatic. Stricture in the prostatic urethra is very rare and always traumatic.

Form of Stricture.—The descriptive distinction of strictures into linear, annular, and irregular or tortuous is merely a matter of clinical

convenience, indicating that the amount of scar tissue in a stricture varies from a slight band or membrane to a broad and irregular mass, extending, perhaps, over the greater part of the anterior urethra. There are two points of much greater importance in this connection.

In the first place, the stricture is usually chiefly built up from the floor of the canal. This is most notable in the bulb, and commonly results in an eccentric position of the orifice of the stricture, close to the upper wall of the canal. The cause is not far to seek. It is in the loose floor of the canal, especially in the pocket of the bulb, that the gonococci commit their greatest ravages. It is the floor of the canal that is most often torn or crushed. It is the floor of the canal that is damaged by overdistention, when urination is obstructed.

In the second place, it is a matter of clinical experience that in the broad, irregular strictures that are clinically multiple, the constrictions become progressively narrower as they approach the bladder. Beginning, perhaps, at the penoscrotal angle, there is a constriction which admits a 20 F. sound. A short distance farther on this, too, is obstructed, and only a 15 F. will pass, and finally the stricture in the bulb admits only a filiform instrument. In other words, the

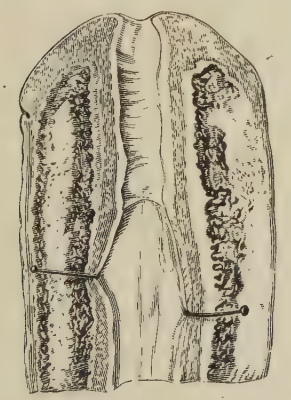


Fig. 53.—Stricture of Anterior Urethra. (Voillemier.)

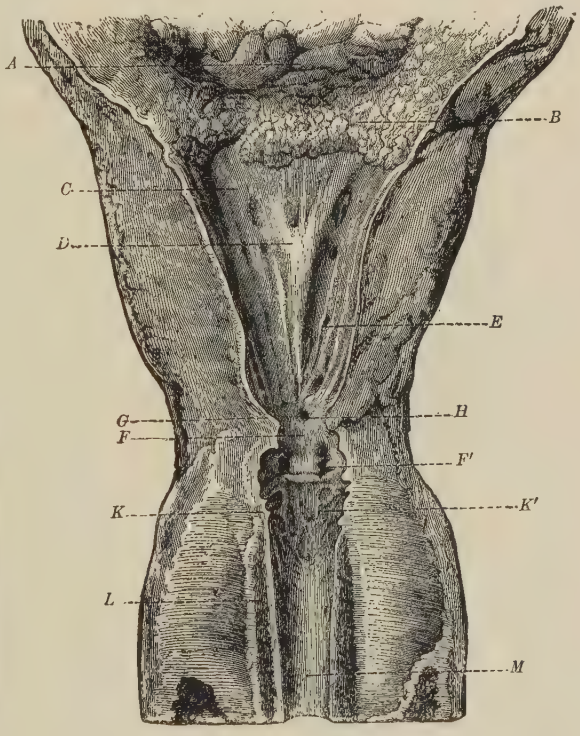
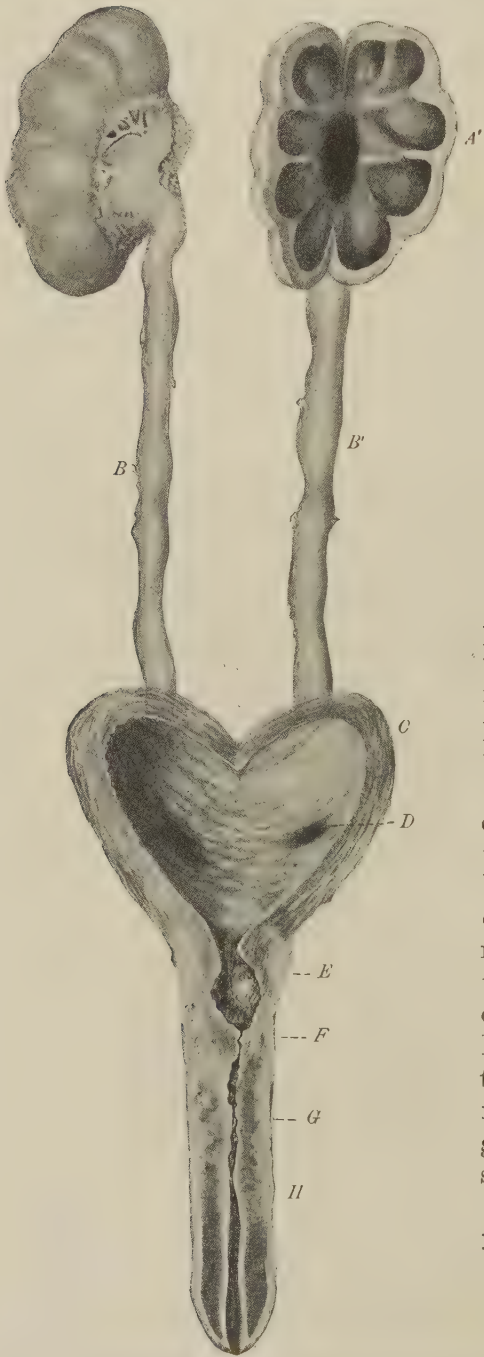


Fig. 54.—Stricture of Membranous Urethra. (Voillemier.) *A*, bladder; *B*, bladder neck (ecchymotic); *C*, dilated prostatic urethra; *D*, verumontanum; *E*, one of the prostatic ducts; *F*, *G*, *K*, the stricture; *F'*, dilatations in front of the tightest part of the stricture; *H*, orifice of small abscess cavity; *K*, mucous membrane in front of the stricture, thin and ulcerated; *L*, corpus spongiosum; *M*, anterior urethra.



deeper extremity of the stricture, which receives the strongest impact of urine, is more irritated than the rest and contracts more rapidly.

Gross Pathological Changes (Figs. 53, 54, 55).—When the strictured urethra is slit longitudinally, the mucous membrane may be found only slightly thickened and congested. The surface may be quite normal in recent cases, though it has usually lost its polish, and may be cicatricial in character or covered with granulations. If the stricture is more advanced, a band or a mass of cicatrix may be found to replace the mucous membrane throughout its thickness, and it may even penetrate the corpus spongiosum, the meshes of which will be found obliterated. This tissue may be slight in extent, cicatricial in character, tightly contracted; or it may be exuberant, knobbed, and excessive in amount, so as to be readily felt from the outside of the canal, having a cartilaginous or even woody hardness. In this callous, fibrous mass there may be irregular areas of recent inflammation, soft congested patches, minute abscesses, and small cavities with

FIG. 55.—RESULTS OF STRICTURE. *A*, *A'*, Kidneys dilated, sclerosed, pyonephrotic; *B*, *B'*, ureters irregularly dilated; *C*, bladder contracted and thickened (concentric hypertrophy); *D*, dilated ureteral orifice; *E*, prostatic urethra dilated (prostatic abscess); *F–H*, the stricture; *F*, its tightest point; *G*, corpora cavernosa involved in the scar.

ulcerated walls. Behind the stricture the canal is distended and more or less extensively ulcerated, and immediately in front of the stricture there may be lesser dilatations and ulcerations.

Microscopic Changes.—These have been described (p. 152).

SUBJECTIVE SYMPTOMS

Organic stricture may exist in a man for years, producing no symptoms and unsuspected. On the other hand, the usual symptoms of stricture, gleet, the irregular stream of urine, and the final dribble, are of daily occurrence among men who have not, and never had, stricture.

Gleet.—The initial symptom is the presence of shreds (*Tripperfäden*) and more or less free pus in the urine. If the stricture follows immediately after a gonorrhea the urethral discharge is perpetuated, but more often there is a lull while the shreds, and perhaps the general cloudiness of urine, persist, but, in the absence of a notable gleet, do not attract the patient's attention. The shreds and pus are evidence of the local inflammation on and about the stricture, which is adding fuel to the flame, and encouraging extension and contraction of the fibrous tissue.

As the stricture contracts the urethral catarrh grows worse and, sooner or later, produces a moderate chronic discharge, perhaps only visible in the morning when the urethra has not been scoured by the urinary stream for eight hours, perhaps persisting throughout the day. This is *gleet*. It is usually the first symptom noted by the patient. The gleet of stricture gets better or worse according to the general condition of the patient, the degree of acidity of the urine, and the amount of sexual indulgence or of venereal excitement. Exacerbations of gleet from slight causes, or repeated attacks of gonorrhea, as the patient usually considers them, often constitute the most marked feature of the case. In fact, it is the rule in mild cases for the patient to be wholly unconscious that his urethra is at all narrowed. He applies for treatment, on account of his gleet, for an attack of gonorrhea, as he calls it, and often refuses to believe that he has stricture, or that, if stricture does exist, it is of sufficient importance to occasion his symptoms; and he asserts that he makes as large a stream of urine as ever. The gleety discharge, once commenced behind the stricture, rarely ceases entirely until the constriction is relieved.

Changes in the Stream.—As the stricture tightens, fresh symptoms are added. The gleet continues, *the stream of urine is small and irregular,* often forked or curving up in a curious manner just after leaving the meatus, or there may be several streams running in different directions, or often one stream is projected for a certain distance, while an-

other drops down perpendicularly from the end of the penis.[1] *The last few drops of urine are retained in the canal,* both mechanically by the obstruction of the stricture, and because the wave of blood, impelled by the contraction of the accelerator urinæ upon the bulb in the final effort at clearing the canal, cannot pass along the corpus spongiosum, on account of the obliteration of its meshes at the point of stricture, and thus fails in its function of expelling the last few drops of urine from the canal. By this same obliteration of spongy tissue, erection is sometimes rendered imperfect and painful.

Frequent Micturition.—In time the surface congestion of the stretched urethra behind the stricture extends backward to the bladder, and brings on irritability (so called) of that organ. The intervals between the acts of micturition grow shorter and shorter, and the acts become more and more painful. Next to gleety discharge this frequency of micturition is the commonest symptom of stricture. A slight narrowing of the canal may occasion it. It is attended by congestion about the neck of the bladder or by true cystitis.

Retention.—The congestion of the urethra behind a stricture may be kindled by a heavy dinner, a little excess in drink, or a chilling of the legs; the mucous membrane swells, the stricture closes, and acute retention of urine results. If this retention is unrelieved, the bladder becomes overstretched, and the case progresses like an acute prostatic retention (p. 298).

Retention may be the only disagreeably prominent symptom connected with a case of stricture. The gleet may not have been noticed, the gradual decrease in the size of the stream may have been ignored, when, after exposure, excess, or a carouse of beer, retention suddenly comes on. Some patients will have had several attacks of retention before they apply for relief. The spasm and inflammation which cause the narrow canal to become obliterated in these cases cease after a few hours, and then the patient goes on perhaps for a year or more without another retention, not suffering noticeably in the meantime.

Hematuria.—Blood sometimes flows with the urine at the beginning or end of the act. Exceptionally *hematuria* may be the most prominent symptom of stricture, indeed the only one noticed by the patient for a long time. I have had several such cases, and have seen the hematuria cease upon relief of the stricture.

Pain.—Along with symptoms of vesical irritation, often before any actual inflammation of the bladder has occurred, are found pains various

[1] It is to be noted that while an impediment anywhere in a water-pipe (such as the urethra) modifies the *force* of the stream, the *shape* of the stream depends chiefly upon the shape of the nozzle (the meatus). Thus the shape of the stream, upon which so much stress is commonly laid, has no bearing on the diagnosis of stricture. It is modified by the meatus itself more often than by any other cause.

in character and situation: pain in the urethra, aching of the glans penis, in the testicle, etc. Such pains are due to prostatitis, cystitis, or retention. Urination is often painful (sometimes excessively so), the pain being at the neck of the bladder, in the perineum, at the point of stricture, or near the glans penis.

Sexual Symptoms.—Erections may be painful, the venereal orgasm attended by pain, the semen not being discharged during the sexual act, but often dribbling away afterwards, perhaps stained with blood, or running back into the bladder, to be discharged at the next flow of urine. Impotence sometimes accompanies this condition. The sexual appetite is often impaired, sometimes nearly obliterated, in old severe cases. But in mild cases the congestion kept up behind the stricture may be just enough to excite and irritate the patient, causing frequent erections, erotic fancies, and nocturnal emissions.

RESULTS OF STRICTURE

Hemorrhoids and Hernia.—The constant straining in urination keeps the hemorrhoidal vessels congested. This not infrequently results in an attack of piles or of rectal prolapse; occasionally, hernia occurs from the same cause. The straining may be so violent that the bowel protrudes at every effort to empty the bladder, making it unsafe for the patient to attempt to urinate except upon a close-stool, for fear of the passage of feces at the same time as the flow of urine.

Prostatitis.—Prostatitis of any degree of acuteness or chronicity is a common result of stricture. It adds its symptoms to the patient's woes.

Cystitis.—The inflammation of the bladder caused by stricture is usually superficial, but it may become parenchymatous. In neglected cases of stricture the bladder usually becomes concentrically hypertrophied (p. 354). When this concentric hypertrophy is of long standing the contracted bladder does not dilate with relief of the stricture: the frequency of urine persists unabated.

Stone.—Urinary calculus is a rare result of stricture.

Pyelonephritis.—Infection and dilatation of the ureters and kidneys occur as in prostatic retention.

RESULTS OF THE MALTREATMENT OF STRICTURE

The results of the maltreatment of stricture are inflammation of the stricture itself, infection of the underlying tissues or of the upper urinary tract, hemorrhage, and false passage. Of these only the last requires detailed mention here.

False Passage.—False passage results from the rough or unskillful use of small instruments in an obstructed urethra.

The surgeon making a false passage may be unconscious of the escape of the point of his instrument from the canal, but he soon perceives that it is behaving unusually. It does not glide along as if in a healthy urethra; it is obstructed, but yet not held as though in the grasp of a stricture. The point, moreover, seems often to be turned out of the median line, and, after the instrument has been introduced far enough to reach the bladder, a rotary motion, imparted to the shaft, will show that the point is fixed in the connective tissue, and not freely movable, as it would be in the cavity of the bladder. In such a case a finger in the rectum will feel the point of the instrument just outside the wall of the gut, at the apex of the prostate, or perhaps lying between the prostate and the gut. On withdrawing the instrument, blood flows freely from the meatus.

Fig. 56.—False Passage. (Dittel.)

RESULTS OF NEGLECTED STRICTURE

In view of recent researches, many of the fundamental notions concerning infiltration of urine have been completely changed, and this condition and its associated phenomena now appear as inflammatory and not as mechanical complications of stricture. Since the time of Voillemier the accepted theory has been that all urethral dilatations and urinary pouches in the region of a stricture, as well as all urinary extravasation and infiltration, are due to the pressure of the urine forced against the weakened, inflamed urethra by the bladder filled to overflowing. The urine was supposed to burst through the urethra, and thus to cause these complications. But a certain number of phenomena are unexplained by this hypothesis. These are:

1. Certain urethral dilatations in front of the stricture. Such dilatations cannot be caused by any urinary pressure.

2. Certain abscesses and urinary pouches opening into the urethra in front of the stricture.

3. Urinary extravasation caused by strictures of large caliber, when the back pressure is by no means sufficiently violent to cause rupture of the urethra.

4. Gangrene of a considerable portion of the urethral mucous membrane behind a stricture of large caliber (Escat [1]).

Moreover, in direct contradiction to the theory of acute extravasation are the observed facts that—

1. The more the bladder is distended the less able is it to exert any great force or to produce more than a dribbling stream, even after the urethral right of way has been reëstablished.

2. When a urinary pocket is opened, and its urethral orifice found, the urine never gushes out, but flows drop by drop.

In short, although the mechanical theory of urinary extravasation explains with charming simplicity the type cases of extravasation—a large invasion of the tissues behind a tight stricture—it does not explain all the phenomena, nor even all the cases of extravasation, and is not compatible with certain clinical facts. Indeed, Escat and Cottet [2] go so far as to deny that the clinical picture of mechanical extravasation exists. The terrible straining and agony suddenly relieved with a feeling of something giving away in the perineum, and soon followed by extravasation, is, it would seem, a description devised to fit a theory.

But if a purely mechanical theory fails to explain the facts, they are fully elucidated on the basis of infection. Without discussing the details, which may be found in the essays of Escat and Cottet, the theory may be set down thus: Although many patients go through all the other complications of stricture, and even come to their deaths thereby, they may never develop any marked urethral dilatation, nor any urinary pouch, abscess, or extravasation. Yet others—even some with stricture of large caliber—especially if enfeebled by alcoholic or other excess or by a long continuance of the disease, may suffer any or all of these local complications.

The inflammation assumes one of the following types:

1. Suppuration within the stricture causes *periurethral abscess,* which—

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[1] *Guyon's Annales,* 1898, xvi, 897 and 1026. This article is a detailed and brilliant elucidation of the whole subject.

[2] *Ibid.,* 1899, xviii, 590.

a. Remains localized and quiescent.
b. Is absorbed.
c. Extends into the perineum and scrotum.
d. Opens into the urethra and—
  α. Discharges and heals.
  β. Remains as a fibrous sac filled continuously or intermittently with urine, and communicating with or shut off from the urethra. (*Urinary pouch.*)
  γ. Fills with urine and bacteria, whose ravages rapidly spread the infection, causing *infiltration, extravasation, phlegmon, abscess, or gangrene.*

2. Suppuration on the surface of the sclerotic tissue, usually behind, sometimes at, and rarely in front of the stricture, may cause *dilatation of the urethra, periurethritis, periurethral abscess* (with the associated lesions just noted), or, if the physical and bacterial conditions are appropriate,[1] *gangrene of the urethra* alone or of the surrounding tissues as well.

3. To fill out and complete the theory that these accidents depend solely upon the combination of individual predisposition and bacterial virulence, two other conditions may be explained by it: the one, *malignant gangrene of the genitals,* a spontaneous gangrene extending over the genitals, sparing the deeper tissues, terminating in recovery, occurring in young subjects with genito-urinary history or disease, and quite comparable to noma, though not fatal; the other, *genital gangrene of old prostatics* long habituated to catheter life, a similar condition, not diabetic in origin, terminating in death (Guyon and Albarran, quoted by Escat). These rare conditions can arise from no source other than a fortuitous combination of soil and seed, comparable to that presented by gangrenous extravasation.

Periurethritis.—In almost any long-strictured urethra there can be felt, by introducing a sound and palpating the canal against it, irregular masses of cicatricial tissue occupying more or less of the whole length of the canal. A sensitive nodule in this mass indicates an area of periurethral inflammation that may, at any time, develop into an abscess.

Periurethral Abscess.—With the onset of suppuration in this tissue there is a sharp, septic febrile reaction. The lump grows rapidly larger, more painful, and tender, and it may encroach upon the urethra sufficiently to cause retention. Ultimately it opens into the urethra, or

[1] Cottet quotes Veillon and Zuber's law: "No gangrene or putrefaction without anaërobic bacteria," and finds in all the cases examined by him that when anaërobic bacteria were present there was gangrene, and when they were absent, even with extensive infiltration, there was no gangrene. He confesses that the suggestion requires further clinical confirmation.

passes into a chronic stage, or more commonly extends into the perineum, burrowing thence throughout the subcutaneous tissue of the external genitals, the thighs, the groins, and even to the lower belly, discharging at many points, and leaving the whole region a mass of fistulæ, through which the urine escapes, perhaps not one drop passing by the natural channel. In these cases the patient makes water sitting, the urine escaping as though through the sprinkler of a watering-pot. Civiale reports such a case with fifty-two external openings.

Urinary Infiltration (*Periurethral Phlegmon, or Urethral and Periurethral Gangrene with or without Urinary Infiltration*).—Beginning as an acute or a chronic periurethral abscess, or as a gangrene of the urethral wall, the acute infective process rapidly spreads over the perineum and the genitals. The first sign is a tender edematous swelling in the median line of the perineum which rapidly increases in size and spreads superficially in every direction. If there is gangrene this reaches the surface within twenty-four or forty-eight hours, and spreads with frightful rapidity. If there is not gangrene the enormous edematous swelling, which may reach the size of a child's head, breaks up into innumerable foci of suppuration, from which pus, and, later, pus and urine pour out. Accompanying all this are shock, severe septic symptoms, and usually retention of urine.

It is usual in these cases for the tumor to be extensively infiltrated with urine, and to contain one or more irregular central cavities filled with urine, necrotic tissue, and pus; but there may be no appreciable infiltration nor any communication with the urethra, and urethrotomy without a guide may be required to relieve the retention.

The bladder never becomes gangrenous, though the urethra slough to its very neck. The suppuration and gangrene may leave a urethrorectal fistula, but the cavity of the pelvis is never invaded.

Inasmuch as urinary infiltration generally occurs in debilitated persons, and is itself a very virulent septic process, it often terminates fatally.

Urinary Fistula.—The periurethral abscess may open and discharge in remote regions,[1] but it usually opens in the perineum.

The internal orifice is usually single, however many the outward openings. The fistula, if long and tortuous or branched, contains diverticula which repeatedly close, form abscesses, and discharge; or they may contain foreign bodies or calculi, or the entire tract may be incrusted with calculus.

Complete urethro-perineal fistulæ have been classified by Thompson as simple fistula, fistula with induration, and fistula with loss of substance.

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[1] Desnos mentions a urinary fistula opening at the lower angle of the scapula.

Simple fistula is a direct tract without indurated walls.

Indurated fistula is embedded in a mass of sclerotic tissue. It may be branched, and is often tubercular or epitheliomatous. Fibromata (Monod) and fibromyomata (Cocteau) are found in the walls.

Prognosis.—Blind internal fistulæ tend to close unless there is stricture. If they persist, there is danger that they may suppurate and form the starting-point for abscess or infiltration.

Blind external fistulæ close spontaneously, or after cauterization or curettage.

Complete fistulæ will close when the impediment to urination (stricture, calculus, foreign body) is removed, unless there is considerable loss of substance, or the fistula is tuberculous or cancerous.

Epithelioma may originate in the walls of the stricture.

DIAGNOSIS

Inasmuch as stricture is only an accentuation of the pathological process that constitutes chronic anterior urethritis, its diagnosis may usually be accomplished by the bulbous bougie (p. 22). But in the clinic stricture is usually seen long after the milder accompanying urethritis has healed; there are certain points in the history and urinary signs that are peculiarly suggestive.

History.—A history of prolonged mild intermittent gleet is peculiarly suggestive of stricture. Spontaneous urethrorrhagia is almost always due to stricture. Retention of urine is due either to stricture, prostatism, or paralysis of the bladder.

The Urine.—Large shreds in the urine are an indication of localized hard infiltrations in the anterior urethra, actual or potential strictures. These shreds may be obscured by free pus; but unless the stricture is controlled by treatment the urine always contains more or less shreds.

Diagnosis of Impassable Stricture.—When a filiform bougie cannot be passed to the bulbous urethra, there is impassable stricture.

If the bougie reaches the bulb but will not enter the membranous urethra, the obstruction is either stricture or spasm. The history usually settles this point, but further investigation must be made. An attempt is made to pass the largest sound that will enter the meatus. If this is passed gently into the bulbous urethra and held against the face of the obstruction, it overcomes the contraction of spasm (p. 245) but absolutely fails to pass the stricture.

Differential Diagnosis.—So much for the method of examination. The presence of an obstruction having been determined, the differential diagnosis lies between organic stricture, spasm, and chronic inflammation. The position of the obstruction and the various points dwelt upon in the preceding paragraphs, and in the chapter on Spasm,

are elements in the diagnosis. But the most distinguishing characteristic of all is resiliency. Organic stricture is always elastic and resilient, the others are not. To test this resiliency a sound—the largest that will pass—is gently introduced through the supposed stricture. It is allowed to rest in place for a moment, and then an attempt is made to withdraw it. *If there be organic stricture the withdrawal of the instrument will be opposed by a firm grasping* as long as the instrument remains engaged in the stricture. If there be no grasping there is no organic stricture.

To tabulate these features briefly—

	Organic Stricture.	Spasm.	Urethritis.
Shreds or pus..	Always present.	Not present unless there is an inflammation.	Always present.
Obstruction....	Always present.	Only in membranous urethra.	Sometimes.
Grasping.....	Always present.	No.	No.

CHAPTER XXIV

STRICTURE OF THE URETHRA: PROGNOSIS AND TREATMENT

PROGNOSIS

Although the prognosis of stricture depends upon the treatment more than upon any other one thing, the progress of the disease varies according to the nature and location of the scar. Traumatic strictures often contract rapidly, in spite of all the surgeon's efforts. Gonorrheal strictures, on the other hand, contract far less energetically. Strictures of the perineal urethra are far more difficult to cure than strictures of the pendulous urethra. The latter contract slowly and are commonly curable; the former contract more rapidly and are, in the majority of cases, incurable—that is, they may be relieved by sounding or urethrotomy, but they usually relapse after a time. Finally, the more extensive a stricture the more irregular its surface, and the denser the cicatricial tissue composing it the more difficult will be its treatment and the more dubious its cure.

In the matter of life or death, however, the prognosis of stricture is far less gloomy. Stricture is very rarely fatal, except in neglected cases. Death occurs in various ways.

1. Extravasation of urine, which, if extensive, kills at once by shock, or, later, by exhaustion, suppuration, abscess, gangrene, or pyemia.

2. Urinary septicemia, the retention resulting in pyelonephritis or pyonephrosis. The patient may die from such a cause even after the stricture has been dilated, or, as is more commonly the case, the treatment itself, whether by sound or knife, may induce a reflex congestion of the diseased kidneys, which closes the scene.

3. Sudden death following the passage of a sound. Such deaths are extremely rare, and are apparently due either to the use of cocain, to *status lymphaticus*, or to nervous shock upon an impaired heart.

TREATMENT

The principle governing the treatment of stricture is simplicity itself. *Enlarge the urethra by dilatation, aided, if necessary, by cutting. Then maintain its caliber by dilatation.* Or perhaps the negative view

is more forcible. *Never cut if you can dilate; and recognize that the patient is not cured unless he stays cured.* Cutting is at best a substitute for dilatation, while divulsion and electricity are no substitutes.

Prophylaxis

Since most strictures are caused by gonorrhea, and the occurrence of gonorrheal stricture is favored by the intensity and the duration of the inflammation, every effort made to control this inflammation is so much toward the prevention of a possible stricture. Yet this is but an indirect prophylaxis, since it is impossible to prophesy which case of gonorrhea will culminate in stricture and which will not. But when the disease becomes chronic *in the anterior urethra,* although there be no stricture present, the inflammation is encouraged by and is in turn encouraging a periurethral sclerosis, which may soon develop into a veritable stricture. Therefore, intelligent treatment of anterior urethritis is the surest preventive of stricture.

For traumatic stricture the proper prophylaxis is immediate perineal section at the time of injury (p. 581).

Curative Treatment

Since the sound is the instrument best adapted to the cure of stricture, and since, unfortunately, it is easier to use a sound wrongly than rightly, a few words on the use and effects of sounds are required.

The surgeon attacking a stricture of the urethra may fairly analyze the therapeutic problem thus: "Here is a scar with a congested surface; shall I cut or shall I massage it?" If he cuts through it the symptoms are relieved, the obstruction is apparently removed, but the scar is still there. In fact, there is rather more scar than ever, and if the former scar contracted and gave trouble, so much the more will this one. To prevent this he will keep the lips of the wound separated by sounds, so that it may heal with so broad an insertion band that the contraction will be of no moment. Such a course may well succeed in the pendulous urethra; but if the stricture is in the perineal urethra and of such density as to give the shadow of an excuse for cutting, it will certainly relapse after the operation unless subjected to systematic massage by sounds. The knife only relieves the congestion plus a temporary relief of the contraction, while the sound actually causes the resorption of the scar tissue. The effect is quite comparable to the reabsorbing effect of massage applied to the outside of the body. Moreover, *the maximum of effect is produced by the minimum of effort,* or, as Guyon puts it, "the effect is due, not to the pressure of the sound, but to its mere contact."

It is a matter of everyday experience that the brutal passage of a

sound, bruising and tearing the congested urethra, is followed by a sharp inflammatory reaction, which increases rather than diminishes the scar tissue. Such treatment is inexcusable. The stricture is already congested, the mucous membrane already inflamed. What more futile procedure than to add irritation to irritation! Such is not the object of the sound. On the contrary, the sound, if a metal one, should slip in almost by its own weight; slowly indeed, but surely. Such a maneuver has the treble effect of lessening congestion at the point of contact, straightening out irregularities in the canal, and stimulating the deeper tissues to a favorable reaction, which will result in softening the cicatrix. But to do this the sound must press without bruising. If a given sound will not pass, try a smaller one. The effect is readily judged. If a sound is properly introduced, it may usually be followed by sounds of the next larger sizes with less pain than the first. Larger sounds may be introduced at each sitting; the rapid amelioration of the symptoms shows that the congestion is relieved, the obstruction is disappearing, and the canal is resuming its normal condition. Yet, however gently a sound is introduced, it will be followed within forty-eight hours by a congestive reaction of more or less intensity. Hence, in treating stricture by dilatation it is bad surgery to introduce instruments—unless filiforms—before the lapse of seventy-two hours, and even longer intervals will often produce better results.

Lastly, and above all, gently, *gently*, GENTLY!

Treatment of Various Kinds of Stricture

The treatment of stricture at the meatus and of spasmodic stricture has been dealt with. Apart from these, the treatment of stricture may be considered under the following captions:

1. Stricture of large caliber.
2. Stricture of small caliber.
3. Stricture admitting only a filiform.
4. Stricture complicated by retention.
5. Impassable stricture.
6. Traumatic and resilient stricture.
7. Inodular or indurated stricture.
8. Stricture complicated by prostatitis. (Irritable stricture.)
9. Stricture complicated by false passage.
10. Stricture complicated by periurethritis.
11. Stricture complicated by prostatic abscess.
12. Stricture complicated by acute pyelonephritis.
13. Stricture complicated by fistula.

1. **Treatment of Uncomplicated Stricture of Large Caliber.**—The majority of strictures which the surgeon is called upon to

treat are of large caliber. The symptom of which the patient complains is persistent gleet, following gonorrhea, with, possibly, some frequency in urination. Too much stress cannot be laid upon the importance of exploring the urethra with the bulbous bougie in such cases. One, two, or more strictures are found; the smallest is probably the deepest.

Treatment here is most simple. After the diagnosis has been made, no further instrumentation is advisable (if the patient can spare the time) until the effect of exploration has been observed. The chances of urethral chill after the first examinations must be remembered. The patient's general condition and habits must be studied, and his urine tested for acidity or possible kidney disease. He must be instructed in urethral hygiene, the nature of his malady must be explained, and, to forestall future disappointment, he should be informed at the outset that, after his symptoms have been removed by treatment, the permanence of his cure, *if his stricture is deep in the urethra,* may depend upon his use of an instrument upon himself at proper intervals, in order to prevent recontraction.

Being instructed not to mind the smarting at his next urination, a few drops of silver nitrate are instilled, and the patient is instructed to take a tablet of hexamethylenamin after each meal and to return in two days for dilatation.

Sounds.—The treatment best adapted to the majority of these cases is dilatation with a conical double taper steel sound. One of these instruments properly warmed and sterilized is introduced in the manner already detailed. Its size should correspond to that of the bougie that has passed the stricture, and the utmost delicacy, care, and gentleness should be used in its introduction. To overcome resistance, patience is better than force. As soon as the instrument has entered the bladder it should be gently withdrawn at once. Nothing is gained by leaving it even for a moment. During withdrawal the stricture is usually felt to grasp the sound. After one sound has been withdrawn, a second and even a third may be introduced, if considered safe. No rule, nothing short of personal experience, can indicate how far the dilatation may be pushed at one sitting. The tendency is always to hurry and to use force, a course detrimental to rapid progress. It may be stated as a rule, subject to judicious exception, that *if a conical steel instrument of any size larger than No. 15 F., when held in proper position, will not enter a stricture almost by its own weight after a little delay, it should not be used.* Every urethra, however, has its own temper; some are aroused by the slightest disturbance, while others bear considerable violence without protest. A surgeon should acquaint himself by gradual experiment with the temper of a given urethra before he takes liberties with it.

The mischief to be feared from the employment of large sounds with

force (besides false passage, which is not likely to be produced by large instruments) is threefold:

1. Epididymitis, a common result of violence to the urethra, and a complication which suspends treatment and confines the patient to bed for several days or weeks.

2. Inflammation in the stricture, which aggravates its condition and defeats the end of the treatment.

3. Chill and urethral fever.

If the stricture is really uncomplicated—i. e., if there is no prostatitis or pyelonephritis—it cannot be irritated except by overtreatment.

The third danger, the chill and fever, is very unusual after manipulation of the pendulous urethra—witness the impunity with which many surgeons cut far and wide through that part of the long-suffering canal—and increases as we approach the bulbo-membranous junction. Some persons have a predisposition in this regard, and the presence of some catarrh of the prostate is essential as a predisposing cause of any real septic chill. Yet in no given case can the prognosis be definite, and the only safety lies in hedging the operation about with all possible precautions. The rule which I have found most efficacious is—

Hexamethylenamin before,

Gentleness during,

Nitrate of silver or permanganate of potash after sounding.

At each subsequent visit of the patient, the surgeon commences with a sound from one to two sizes smaller than the last instrument introduced at the previous visit, and carries the dilatation as far as possible without the employment of force, till the full size is reached.

The most important feature in the treatment of stricture by dilatation is a proper regulation of the intervals to be allowed between the visits. The intervals usually recommended are too short. Occasionally we see patients who attempt to treat themselves, introducing a bougie into the urethra daily, or twice daily, perhaps at every act of urination, aggravating every symptom, worrying the urethra and bladder into a state of inflammation, and wondering why the stricture does not get well. Some surgeons, unfortunately, are guilty of the same error. We can only repeat that *it is bad surgery, in treating stricture by dilatation, to reintroduce instruments—unless filiform—before the lapse of at least seventy-two hours, and even longer intervals will often produce better results.*

As to the degree of dilatation which is to be aimed at, every urethra has its own gauge in the size of its meatus—provided that meatus be not congenitally small, or contracted by disease. If there is any cicatricial tissue in the circle of the meatus, or if a probe can make out any pouching below the lower commissure (Fig. 52), the meatus is too small.

The normal meatus, however, is the smallest part of the healthy canal, and the object in view is to bring all available pressure to bear upon a morbid narrowing of some other portion of the tube. To do this the meatus must be lightly put upon the stretch. When this is done, the feeling is one of discomfort, which subsides after the instrument has been in place for a moment. If the meatus is overstretched, a distinctly marked, narrow white line will be seen encircling the instrument upon the lips of the urethral orifice, indicating that the latter have been deprived of blood by pressure. The use of double taper sounds makes this stretching transitory, and therefore much more bearable.

In the majority of cases this physiological gauge—the normal meatus—is absolutely satisfactory. A stricture once dilated to this size—which will vary from 27 to 32 F.—will stand the test of a cure—that is, the inflammation about it (not necessarily the prostatitis) will rapidly disappear, and the stricture will not recontract during the lengthened intervals of sounding that constitute the after-treatment. But occasionally the meatus is too small a gauge. The outer fibers of the scar lie so deep and are so elastic that they are unaffected by the pressure and tend to recontract as soon as the lengthened intervals of sounding permit them to do so. Such strictures must be cut or stretched until a point is reached where they do not recontract. To do this the integrity of the meatus must often be sacrificed.

Otis's Theory.—Such was the basis of Dr. Otis's famous theory. Meeting many strictures incurable by the half-hearted methods of dilatation then in vogue, and finding that a generous incision cured stricture of the anterior urethra, he evolved the theory that the urethra is an evenly calibrated tube whose size bears a direct relation to that of the flaccid penis. This ratio he fixed at 10 mm. of urethral circumference to every inch of penile circumference. Thus, a 3-inch penis should take a 30 F.; a 3½-inch penis a 34 F. The objection to Dr. Otis's theory is that it is incorrect. The urethra is no more an evenly calibrated tube than the ureter, the esophagus, or the bowel. Its size no more varies with that of the penis than does the size of the esophagus with that of the neck. The objection to Dr. Otis's practice is that it involves an unnecessary and harmful amount of cutting, since, as a rule, the patient can get well without it, and the operation may leave a canal defective in expulsive power. Moreover, though this wide cutting cures strictures of the pendulous urethra, it does not cure deep strictures. The latter get well sometimes under all varieties of treatment—in most instances they require the occasional use of sounds for an indefinite period.

Yet Dr. Otis's work deserves the highest praise, in that he has shown us what great sizes may be attained with safety. And although he has not proved that his treatment is always essential, he has proved it most desirable in strictures of the anterior urethra incurable by a moderate

course of sounds. Only recently Albarran and Guiard in France have insisted that some strictures must be dilated above 23 F.

Dilators.—There is no question but that sounds of a size readily admitted by the meatus may be passed with less discomfort to the patient than any dilator. But if the meatus is congenitally narrowed and the patient objects to having it cut, or if the stricture when dilated to the size of the meatus recontracts with undue rapidity, further dilatation may be performed by the Kollmann dilator. This instrument is employed in the same manner as in the treatment of chronic urethritis.

Urethrotomy.—If at any stage of dilatation the stricture rebels and can not be dilated any further, urethrotomy must be resorted to.

Choice of Urethrotomy.—As was mentioned in describing the operations, external section is best suited to deep strictures, internal section to strictures of the pendulous urethra. There still remains a choice of instruments for internal urethrotomy, which choice is simply a matter of taste. For my part, I like the bistoury for strictures near the meatus, Otis's dilating urethrotome for any other stricture large enough to admit that instrument, and Maisonneuve's urethrotome only for those strictures through which an Otis instrument will not pass.

After-treatment.—The after-treatment depends upon the location of the stricture.

If the stricture is in the pendulous urethra, the surgeon may feel confident that a cure persisting three months will prove permanent. When the stricture has been dilated fully, so that there are no longer any large shreds in the urine (unless from the posterior urethra), the patient may be dismissed to report in two weeks. If at that time there is no recontraction, he may be dismissed for a month, and again for two months, when his cure may be pronounced permanent. If, however, there is a relapse on any of these occasions, biweekly visits must be renewed, and the patient's cure insured by higher dilatation or a further cutting.

If the stricture is in the bulb the matter is different. In all such strictures, except those soft bands that yield to one or two passages of a sound, recontraction will almost inevitably take place, unless the cure be maintained by the passage of a full-sized sound. This is easily done by the patient. In a few lessons he acquires the art of gently passing a sound upon himself, and he should be seriously cautioned to perform this trifling but important operation once or twice a year. If the sound fails to pass on some such occasion he must report for examination. In this way, in some cases, the use of instruments may be gradually abandoned; in the majority, it will have to be continued indefinitely, at intervals varying from a week to a year. Thus the cure becomes radical. The surgeon is responsible for the cure only on condition that the patient carries out this plan; or, rather, the patient is responsible for the

permanence of his own cure, and this he must be made distinctly to understand.

2. **Stricture of Small Caliber.**—To this class belong strictures admitting any instrument less than No. 15 F. They are considered separately, not because they require different treatment, but in order to emphasize the fact that they are better treated with soft than with steel instruments. The danger of making a false passage in an obstructed urethra with a small metallic instrument cannot be overrated. No one can appreciate the ease with which a false passage is made until he has himself made one. Indeed, a surgeon, not well acquainted with the urethra, may make a false passage, and go on dilating it instead of the stricture, wondering meantime that the size of the stream is not increased nor the symptoms alleviated. A surgeon who knows every line of the urethra may occasionally assume the risk of using a small metallic instrument in the canal without a guide, but only in exceptional cases. Below No. 15, soft instruments only should be employed, unless there be a guide through the stricture.

Dilatation is carried on as already directed, steel instruments being used as soon as the stricture will admit No. 15.

Urethrotomy.—Cutting may be resorted to:

a. If the stricture will not dilate.

b. If the patient has not the time to go through a long course of dilatation.

c. If urethral fever follows all attempts at dilatation.

3. **Stricture Admitting Only a Filiform, but Not Complicated by Retention.**—In commencing the treatment it may be impossible to enter the bladder with any instrument, either on account of the tightness of the stricture, or because the point of the instrument does not engage in the latter, or is arrested by some fold beyond. In these cases gentle perseverance and skill will rarely fail of success. Each of the different varieties of filiform bougies has its champions. I have obtained the best results from the Banks bougie.

Introduction of Filiforms.—Filiforms are apt to catch in the urethral folds and crypts both in front of and behind the stricture. The following maneuvers are employed to overcome this difficulty:

1. When an instrument catches, partially withdraw and slightly rotate it, pushing it forward while making the rotatory movement. This device rarely fails in finally engaging the instrument in the orifice of the stricture, especially if the filiform point be bent or twisted in any direction (spiral or zigzag), so that its extremity may lie outside of the axis of the shaft of the instrument.

2. An excellent method of finding the orifice of a stricture consists in cramming the urethra full of filiform bougies, engaging their points in all the lacunæ and false passages, and then trying them, one after

another, until that one is pushed forward which is presenting at the orifice of the stricture, when it will at once engage (Fig. 57).

3. If the point of the filiform passes the stricture but catches in the prostatic urethra, it may be lifted into the bladder by a finger introduced into the rectum.

4. If the stricture is a single band the face of which may be reached by the urethroscope, this instrument is introduced, the stricture wiped with adrenalin until it ceases to bleed, and a filiform then introduced, guided by direct ocular observation. This maneuver rarely succeeds where other means fail.

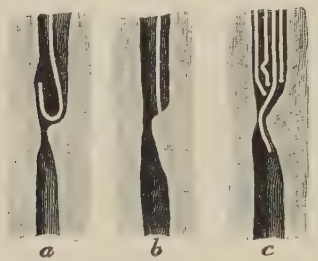

FIG. 57.—INTRODUCTION OF FILIFORMS. (Bryant.) *a*, guide bent upward; *b*, guide in lacuna; *c*, numerous guides in urethra, one passing stricture.

In those exceptional cases where a filiform bougie can be introduced only after long and persevering effort,[1] it becomes a serious question whether it is not better either to tie it in, thus obtaining a more rapid and certain dilatation, or to perform urethrotomy at once rather than to incur the risk of having to operate without a guide later. The temptation to operate on such a case is great, but the necessity for operation is more apparent than real. The selection of treatment depends upon the requirements of the case. Urethrotomy is certain, and is usually the speediest cure, but it is an operation. Continuous dilatation, with the filiform tied in, is somewhat dangerous if the patient is up and about, but is a very satisfactory way of commencing treatment if he is willing to go to bed for a few days. Intermittent dilatation may result in retention, leaving him worse off than at first; yet, as a rule, on the third day the filiform may be reintroduced and followed by larger instruments, and the cure is under way. The disagreeable alternative is altogether done away with by the use of the Banks bougie or the guided sound.

If continued dilatation is selected, the filiform should be replaced on the second or the third day by a slightly larger instrument, and this removed one or two days later, after which intermittent dilatation may be taken up, or dilatation may be begun when the filiform is removed.

4. Retention.—A patient with stricture may be enjoying good health, when suddenly, after exposure to cold, after a dinner or a carouse, or after the passage of a small instrument through his stricture, he finds that he cannot pass water. Immediate relief is required. In

[1] In one (personal) case it required ten sittings, most of them over one hour long, before any instrument could be made to enter the bladder. At the tenth effort the instrument passed.

this condition a fine catheter can sometimes be introduced by the exercise of patient gentleness and skill. When the bladder is reached, a flow of urine follows. If the bladder cannot be reached, the patient should be placed in a hot bath, more hot water being added after he has become accustomed to the first heat, and this carried as high as bearable. He should remain in the bath from fifteen to twenty minutes, and will often be able to empty his bladder while in the water. A sitz bath, at a temperature of 100° to 104° F., is sometimes more effective than a full bath, but it should only be continued for about three minutes, and may be repeated after an interval of fifteen minutes. If the heat is sufficient to induce nausea or faintness, it is more likely to produce the desired effect of relaxing the stricture. Following this relief an attempt at dilatation should be made as described in the preceding section.

If these expedients fail, the bladder may be aspirated every eight hours for one day. Then the patient is put into a hot bath for twenty minutes and a final attempt made to introduce a filiform. This failing, the stricture may be fairly considered impassable.

In drawing the urine from a distended bladder it is well not to remove more than 500 c.c. (℥ xvj) at a time. If there is more than this, draw off the remainder after twenty minutes. Too quick emptying of an acutely distended bladder has been followed by hemorrhage, collapse, and even sudden death.

5. **Impassable Stricture.**—No stricture (congenital atresia excepted) is impervious unless the urethra has been cut across and all the urine escapes behind the cut, or unless the urine escapes through large fistulæ. If a drop of urine can pass, the stricture is pervious, but nevertheless it may be impassable to any instrument, or to any skill and patience we may bring to bear upon it, and that, too, although the urine flows in a considerable stream. The absence of retention relieves the surgeon of the immediate necessity of emptying the patient's bladder and gives him time to coax the stricture into admitting an instrument.

How far the surgeon shall continue coaxing the urethra before resorting to external urethrotomy without a guide is a matter to be decided on the merits of each individual case. If the patient has had retention before, his experience then will aid in forming a judgment. If the surgeon is acquainted with the temper of the urethra and the character of the stricture (resiliency, traumatic origin), he may found his opinion on such previous knowledge. If the patient is difficult to manage, and there is fear that, once relieved from his present necessity, he may not submit to treatment, it is a kindness to take advantage of his misfortune by insisting upon perineal section at once, thus putting him in the way of keeping off further trouble by the passage of a large instrument.

But external perineal urethrotomy without a guide is a difficult operation, and is not to be undertaken unadvisedly. If it is the patient's

first retention, if he was previously passing a fair-sized stream, and if the bladder is not already too full, it is always well to try palliative measures. But, on the other hand, it is not wise to fritter away time to the permanent detriment of the patient's bladder and kidneys when a stroke of the knife would solve the difficulty.

6. **Traumatic and Other Resilient Strictures.**—Traumatic strictures close down with great rapidity and are very rebellious to treatment. They are resilient. When dilated ever so little they recontract and often are made worse, rather than better, by sounds. Under such conditions dilatation is a losing game. The knife must be used. When the scar is linear, simple perineal section will suffice to render it amenable to the sound. When, as is often the case, the scar is annular and fibrous, all the scar tissue, both on roof and floor, must be cut away. The urethral wound may need to be closed by suture or graft, but that does not signify: the scar must be removed at all costs, since it never loses its retractile quality, and simple section will be followed by a recontraction almost as rapid as after the original injury.

Other resilient strictures must be dealt with similarly.

7. **Inodular or Indurated Stricture.**—Strictures which involve a considerable length of the urethra, masses of scar whose irregularities can be felt externally, and strictures complicated by fistula often do ill under dilatation. When they come to operation they may perhaps be improved by simple section, but the only way to do them justice is to excise the urethral roof and floor and, if necessary, to fill in the gap by suture or graft.

8. **Stricture Complicated by Prostatitis** (*Irritable Stricture*).—Strictures classed as irritable in reality present no peculiar irritability in themselves, but they are complicated by a catarrhal prostatitis. As soon as the point of the sound or the bougie passes well through the stricture it glides over the prostatic urethra, the really irritable point—though, be it understood, only the minority of strictures complicated by prostatitis are irritable—and provokes an exacerbation of the prostatic inflammation or a sharp chill. When such a complication presents itself the simplest solution is perineal section; but this is not always essential. By bracing the patient's general health, by employing rather large doses of hexamethylenamin, by using the utmost gentleness in sounding, by preferring bougies, which are less violent to the prostatic urethra than sounds, or else blunt sounds whose points need not enter the prostate at all, and by treating the stricture only sufficiently to permit local treatment of the prostatitis until the latter is materially improved—by such means the operation may often be avoided.

9. **Stricture Complicated by False Passage.**—The treatment for a fresh false passage is to let it absolutely alone for two weeks, if the patient can urinate, and is in no pressing need of relief. Blood

will flow for a day or two, then pus for a few days, and at the end of two weeks, in favorable cases, the passage opened by the instrument will have closed. Occasionally it remains open, suppurating for a much longer time. The great danger in these cases is in recommencing instrumentation too soon, entering the false passage before it has healed, and thus keeping it open indefinitely.

In avoiding an old false passage, the seat of chronic suppuration, its position must be accurately studied out, by observing at what point in the urethra an instrument engages in it, and from which wall of the canal (upper or lower [1]) it starts. The orifice of a false passage once accurately located, may be subsequently avoided by making an effort to present the beak of the instrument at a different portion of the canal when passing the dangerous point. A new false passage does not grasp an instrument like a stricture, and in this way can often be distinguished from the latter. An old false passage, however, so far as its pathology is concerned, is a traumatic stricture. It has hard walls, and the scar tissue around it will grasp like any other stricture, thus depriving the surgeon of a very valuable means of deciding whether or not he is in the strictured canal of the urethra.

10. **Stricture Complicated by Periurethritis.**—**Prophylaxis.**—No serious disorder is more entirely preventable than urinary infiltration. Intelligent treatment of the stricture and early incision of all foci of suppuration about the perineal urethra would suffice to obliterate the condition. But even passing over these precautions, there is a very fair proportion of cases that have their dumb ague for days with but slight local symptoms until, finally, they burst into full infiltration, and it is too late. A careful physical examination would disclose a tender perineal mass, the proper incision of which might save a life.

Radical Treatment.—There is no sane palliative treatment of periurethritis and its complications. The *simple inflammatory areas* should be treated by methodical soundings, perhaps aided by hot sitz baths and leeches to the perineum. Under such a course they rapidly suppurate or disappear.

Periurethral abscess requires prompt evacuation and drainage by median perineal incision. The urethra should be opened and the stricture cut. In dealing with small abscesses this is a simple matter. Large ones should be cut and drained like infiltrations.

Infiltration of urine demands immediate and radical incision. The patient's life is entirely in the surgeon's hands. Timorous incision is

[1] Guyon states that he never met a false passage on the roof, hence advises following that wall of the urethra to avoid it. I have, however, met two cases of false passage on the roof, as shown by external urethrotomy, and have seen one other with the urethroscope.

the patient's death-warrant. The infiltrated area must be slit open from end to end. Necrotic tissue must be sacrificed with no thought of ultimate disfiguration.

11. **Stricture Complicated by Prostatic Abscess.**—Perineal section should be performed immediately; the stricture cut, the abscess drained.

12. **Stricture Complicated by Acute Pyelonephritis.**—The kidney must be drained either by a retained catheter or by perineal section. The tube should remain in place until the temperature touches normal. This failing, nephrotomy is required.

13. **Stricture Complicated by Fistula.**—The chief aim in the treatment of fistula is to remove the impediment to urination—in most cases to *dilate the stricture.* This done, every simple fistula will close itself; but as long as the urethra is obstructed the urine will seek the freest outlet—viz., the fistula.

Indurated fistula is usually associated with resilient or impassable stricture. To cure it all the scar tissue about the fistula and the urethra must be excised and external urethrotomy performed.

The injection of a concentrated solution of hydrogen peroxid, which has proved so eminently curative of the baffling penile fistula (p. 228), may also prove serviceable for the cure of perineal fistula. Fistula with loss of substance requires a plastic operation.

Summary of Treatment of Stricture

1. Alkalies, diluents, and rest are serviceable in some cases of stricture; indispensable if there be any serious complication.

2. All uncomplicated strictures, not highly irritable or resilient, should be treated by dilatation with soft instruments up to No. 15 F., and with conical steel sounds afterwards; reintroductions being made every fourth day.

3. Until well acquainted with the temper of a given stricture, every sounding should be preceded by hexamethylenamin, followed by nitrate of silver.

4. Dilatation need rarely be carried beyond the caliber of the normal meatus.

5. Any stricture resisting dilatation must be cut.

6. For the pendulous urethra, internal urethrotomy. For the perineal urethra, external urethrotomy or the combined operation.

7. In general, anterior stricture of the urethra is curable, deep stricture of the urethra incurable.

8. Impassable stricture without retention may usually be overcome with filiform bougies by time, patience, and skill. If finally proved impassable, the treatment is external perineal urethrotomy.

9. Retention is treated by hot baths; these failing, by aspiration, or by external urethrotomy without a guide.

10. Traumatic stricture may be prevented by section at the time of injury. Once having shown itself, it usually requires excision for a cure.

11. Resilient and inodular strictures are best treated by excision.

12. Irritable strictures may often be cured without cutting.

13. Acute inflammatory complications usually call for operation.

CHAPTER XXV

THE PROSTATE: ANATOMY, PHYSIOLOGY—PROSTATIC HYPERTROPHY: ETIOLOGY, MORBID ANATOMY

ANATOMY

The prostate (*πρόστατα, standing before*) is a sexual organ, partly glandular, partly muscular, lying in front of the bladder about the prostatic urethra (Fig. 58).

In shape the prostate is an irregular truncated cone. It has been aptly compared to a horse-chestnut. Its apex rests against the posterior layer of the triangular ligament. Its base, toward the bladder, is pierced above by the urethra, below by the ejaculatory ducts. Its upper (anterior) and lateral surfaces are rounded, its lower (posterior) surface presents a boss on each side of the median line. It is to this lower surface particularly that the title heart-shaped or chestnut-shaped applies.

The *diameters* of the prostate, as given by von Frisch [1] (and Thompson [2]) are: length, 33 to 45 mm. (25 to 30 mm.); width at the base, 34 to 51 mm. (32 to 40 mm.); thickness, 13 to 24 mm. (20 to 25 mm.). Its *weight* is 16 to 20 grams. In *position* it is 8 to 12 mm. below the symphysis, and its apex is 30 to 40 mm. from the anus. Its long axis makes an angle of 20 to 25 degrees with the perpendicular.

The prostate is supported by the pubo-prostatic ligaments and the levator prostatæ (anterior fibers of the levator ani).

It is fixed in its relations to the urinary organs by the urethra, which pierces it from base to apex, as well as by the decussation of its muscular fibers with those of the bladder and the urethra. It is separated from the pubic arch above and in front and from the rectum behind by a loose fascia containing the large prostatic plexus of veins.

The prostate is composed of two *lateral lobes* that develop independently during the first half of intra-uterine life, and then become united behind the urethra by the so-called *posterior commissure* (isthmus, pars intermedia), at the same time covering over the urethra by a thin layer, the *anterior commissure*. In the adult prostate

[1] Nothnagel's *Specielle Path. u. Therap.*, 1899, xix, ii, iii, 4.
[2] "The Diseases of the Prostate," 1883, p. 5.

the lateral lobes are felt as bosses on the under surface of the organ, the posterior commissure as the groove between them. The so-called *third or middle lobe* and the prostatic *bar* are products of senile and inflammatory changes, and are not found in the normal prostate.

Structure.—On section the prostate is found surrounded by a dense fibrous capsule that sends thin septa inward between the glands and among the muscle fibers. The organ itself is composed mainly of unstriped muscle and glandular elements. There is a framework of connective tissue which contains many elastic fibers. Authorities are curiously at variance as to the relative amount of muscular and glandular tissue in the organ. Thus Kölliker (von Frisch) states that from two thirds to three fourths of the organ is muscular, while Rüdinger (*ibid.*) says that the glands occupy from one third to four fifths of the whole; finally, Walker insists that the glandular substance forms five sixths of the organ.[1] However that may be, it is acknowledged that the glands are densest in the lateral masses and the posterior commissure (especially its upper part), while in the anterior commissure the glands are few or wanting altogether.

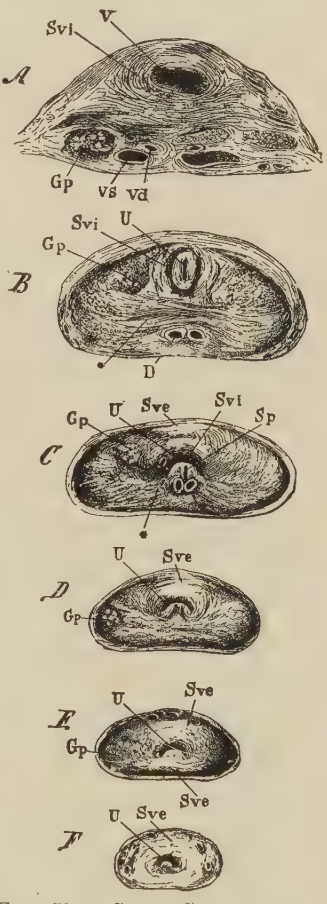

Fig. 58. — Cross Sections of Prostate in a Series from Base to Apex. (Morrow.) *V*, urethral orifice of bladder; *U*, urethra; *Vd*, vas deferens; *Vs*, vesiculæ seminales; *D*, ejaculatory duct; *Sp*, utricle; *Svi* and *Sve*, sphincter vesicæ internus and sphincter vesicæ externus; *, muscular septa.

The *muscular tissue* is arranged in so irregular a manner that no two observers are agreed as to its exact distribution. Walker believes that the prostatic muscle is so arranged as to compress the gland as a whole, and each individual lobule of it in particular, but is not calculated to compress the urethra. This view is in accord with the fact that women—who possess no prostate—have complete control of the bladder without any additional muscle to take the place of this gland.

The *glands* are of the compound racemose type with columnar epithelium, which may be flattened by pressure. They are collected into

[1] Johns Hopkins Bull., 1900, xi, 242.

lobules, each lobule surrounded by a layer of muscle and emptying by a duct into the lateral portions of the floor of the prostatic urethra, some behind and some in front of the verumontanum. Walker has shown that in dogs all these ducts point toward the orifices of the ejaculatory ducts, so that the prostatic secretion is mingled with the semen at the moment of ejaculation. The lobules of glandular tissue are chiefly contained in the lateral lobes and the posterior commissure.

A small but important group of glands lies upon the floor of the urethra within the grasp of the sphincter. It is from the hypertrophy of these glands that the prostatic middle lobe develops.

The Prostatic Urethra.—The urethra extends from the bladder downward and forward through the prostate, so that, although the major part of the gland lies below and behind it, the urethra emerges quite at the center of the apex of the prostate. The anatomy of the prostatic urethra has already been described.

PHYSIOLOGY

The prostate is the sexual heart. It has nothing to do with urination, and is quite passive during this act.[1] But toward the sexual function it acts as a muscle, a sensory organ, and a gland.

As a *muscle* it acts to open the ejaculatory ducts, thus permitting the escape of the semen into the prostatic urethra, to express its own secretion into the prostatic urethra, and probably to expel it into the anterior urethra. The accepted function of the verumontanum—viz., to close the vesical orifice and prevent regurgitation of semen into the bladder—has been denied by Walker.

The seat of *sensation* in the prostatic urethra is, perhaps, throughout its mucous membrane, but more probably it is confined to the verumontanum. When erection has been stimulated by friction of the glans penis the verumontanum becomes congested and irritated, perhaps by a spinal reflex, perhaps by the gradual influx of semen into the prostatic urethra, and ejaculation results. Thus it is quite logical that pollutions and premature ejaculations should be caused by hypersensitiveness in the verumontanum, and should be curable by treatment directed toward blunting the sensitiveness of that region.

The *glandular function* of the prostate is no less interesting. Many investigators confirm the observation that the spermatozoa are immobile in the testicle and the seminal vesicle. This immobility is in part due to the density of the semen, for dilution with any fluid provokes evidence of life in these microörganisms. The prostatic secretion performs this

[1] For the various aspects of this disputed question consult, besides the authors already quoted, Rehfisch, *Virchow's Archiv*, 1897, cl, 111; Finger, *Allg. Wien. med. Zeitung* 1893, xxxviii, 427, 439, 452.

function. But, besides acting as a simple diluent, it adds something to the semen that keeps the spermatozoa alive some twenty-four hours, whereas other diluting fluids keep them alive only three or four hours.

The *secretion* of the prostate is a thin, turbid fluid of watery consistence (not ropy or sticky), of slight acid reaction, and of seminal odor. Its qualities in health and disease have already been described.

PROSTATIC HYPERTROPHY

The true nature and pathogenesis of hypertrophy of the prostate are not known. We can only describe it as a disease of the latter years of life, a chronic, noninflammatory hyperplasia of all the tissues of the gland, but especially of the epithelial elements, diffuse in its character, and subject to inflammatory attacks and secondary fibrous metamorphosis.

ETIOLOGY

Age.—The one thing known about the etiology of prostatic hypertrophy is that it occurs at middle age, never giving any trouble before the forty-fifth year, and rarely appearing after the seventieth. Although individual cases have been reported at the ages of nineteen (Stretton), twenty-five (Englisch), thirty-seven (Thompson), etc., the disease cannot be looked for before forty-five. We shall see that the prostate begins to hypertrophy early in life, yet there is no clinical evidence of any such change until many years later. The patients begin to suffer, for the most part, between the ages of fifty and sixty-five.

To explain the relative infrequency of hypertrophy of the prostate after the seventy-fifth year, Thompson has advanced a theory that the physiological atrophy of old age makes itself felt at this time of life, so that if a man escape until then he is all the more likely to escape thereafter. This senile atrophy does not, however, promise any relief to the sufferer, for when once the urinary mechanism has been upset by the hypertrophy the secondary phenomena cannot be alleviated by any slight atrophy of old age.

Frequency.—According to Thompson's figures, 34 per cent of men reaching the age of sixty have enlarged prostates, and less than half of these (15 per cent to 16 per cent of the whole) suffer from the disease. Many authors give far higher estimates. Thus Johnson,[1] in examining the prostates of 360 men, found hypertrophy present in 79 per cent, yet only 16 per cent—Thompson's own estimate—suffered from the disease.

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[1] *Internat. Jour. of Surgery*, 1899, xii, 98.

The size of the hypertrophy bears no relation to the age of the patient, nor, as we shall see, to the symptoms.

Pathogenesis.—Though no satisfactory theory has yet been advanced to account for hypertrophy of the prostate, many ingenious suppositions have had ardent defenders, and so require at least a brief notice.

1. *Arteriosclerosis* (Guyon,[1] Launois [2]).—The lesion of the prostate is supposed to be only part of a series of senile changes affecting the whole urinary tract and associated with general arteriosclerosis.

Casper [3] and Motz [4] overthrew this theory by showing that sclerosis could exist without hypertrophy, and hypertrophy without sclerosis. The association of the two appears to be purely fortuitous.

2. *Fibro-myoma* (Velpeau [5]).—Velpeau suggested that there exists a biological analogy between the prostate and the uterus, and a histological analogy between fibro-myoma of the uterus and hypertrophy of the prostate. Thompson [6] amplified and defended the theory, and it has received additional weight by the alleged effects of castration upon uterine myoma and prostatic hypertrophy.

This theory has been exploded by the modern recognition of the fact that the prostate is analogous to the uterus neither in development, in structure, nor in function, and that the hypertrophied prostate is not fibro-myomatous, but adeno-fibromatous.

3. *Sexual Senility* (White [7]).—"The function of the testis, like that of the ovary, is twofold—the reproduction of the species and the development and preservation of the secondary sexual characteristics of the individual. The need for the exercise of the latter function ceases when full adult life is reached, but it is possible that the activity of the testis and that of the ovary in this respect do not disappear coincidently, and that hypertrophies in closely allied organs like the prostate and uterus are the result of this misdirected energy." The facts adduced by White cannot be denied; but his theory, based upon the false prostato-uterine analogy and the implied power of the testicle to cause hypertrophy of the prostate and devised to defend the cause of castration as a remedy for hypertrophy of the prostate, is an assumption not borne out by the facts.

4. *Congestion.*—A chronic congestion of the gland has been considered by many the chief predisposing cause of prostatic hypertrophy. Many varieties of congestion have been insisted upon. Some authors

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[1] *Guyon's Annales*, 1885, iii, 148.

[2] "De l'appareil urinaire des vieillards," Paris, 1885.

[3] *Virchow's Archiv*, 1891, cxxvi, 139.

[4] "Structure histologique de l'hypertrophie de la prostate," Paris, 1896.

[5] "Leçons orales," Paris, 1841, iii, 478.

[6] "On the Diseases of the Prostate." Fourth edition, 1873, p. 53.

[7] *Annals of Surgery*, 1893, xviii, 152.

incriminate a pelvic congestion, such as is caused by gormandizing and a sedentary life, and expressed by hemorrhoids. Others insist upon chronic urethritis or sexual excess; and a few would even blame a too strict continence.

Young has noted that most of his patients were married men.

5. *Inflammation.*—The *neoplastic theory* of prostatic hypertrophy is so immediately suggested by the very appearance of the enlarged gland—which seems to be full of tumors—that it has not been seriously questioned until recent years. Since the time of Griffith, indeed, we have known that the so-called myoma of the prostate was, in fact, fibroma, or adeno-fibroma, and strict thinkers have always recognized that the prostate was not the analogue of the uterus, and, therefore, the adeno-fibromatous gland not comparable to the fibromatous uterus.

But these small differences sink into insignificance in the light thrown upon the subject by Ciechanowski's [1] observations. This Polish pathologist has proven that the so-called hypertrophy of the prostate gland is not due to a neoplastic formation; that the senile changes in the prostate—whether they be atrophy or hypertrophy—are essentially the same; that these are due to obscure, inflammatory processes originating in the stroma of the gland; and that the so-called adenomata and fibromata are secondary changes due to the dilatation of gland ducts and acini whose mouths are obstructed.

These revolutionary doctrines have been confirmed by Greene and Brooks [2] and Crandon,[3] and indirectly by Rothschild,[4] and have not been controverted.

It is impracticable here to go into the details of the theory, since this is a very complex matter. It need only to be observed that the great majority of prostates of men at middle age show evidences of chronic inflammation of the stroma. If these areas of chronic inflammation are situated chiefly in the periphery of the gland, their tendency is to compress it and to cause prostatic atrophy. If located near the urethra, such areas of inflammation may surround and obstruct any or all of the efferent ducts of the prostate. When this occurs the ducts behind the obstruction dilate, and, inasmuch as these ducts run in a crescentic manner and their tendency to dilate is restricted by the dense, fibrous capsule of the prostate, they become somewhat distended by the products of secretion, forming the small cysts (Fig. 60) that are seen throughout the hypertrophied prostate, but they tend more particularly to flat-

[1] "So-called Prostatic Hypertrophy," translation edited by Dr. R. H. Greene, 1903.

[2] *Jour. Am. Med. Ass'n,* 1902.

[3] *Annals of Surgery,* 1902.

[4] *Centralblatt f. d. Krankheiten d. Harn- u. Sexual-organe,* 1904.

ten out and to curve around islands of glandular and muscular tissue. These islands, varying in size, may thus become almost completely encapsulated by the dilated duct.

Such are the pseudo-adenomata which secondary fibrous changes resulting from further inflammation may transmute into fibromata.

The Effect of Gonorrhea.—Ciechanowski notes the fact that the underlying stroma changes found by him in the prostates of old men are the same as those found by Casper in the prostates of young men who had suffered from gonorrheal prostatitis. Hence the inevitable corollary that perhaps the hypertrophy of old age is due to the gonorrhea of youth. This suggestion, tentatively set forth by Ciechanowski, has been seized upon by several writers as an unavoidable inference, and is by them flaunted to the great shame of a large and respectable army of prostatics.

In order to test this theory from the clinical side, I have collected [1] the histories of a great number of men who have reached the age of fifty after having suffered prolonged attacks of chronic gonorrhea, and cannot find that they show any special tendency to suffer from prostatic hypertrophy. This, taken in connection with the fact that every established genito-urinary practitioner can call to mind many prostatics who —he may be morally certain—never had gonorrhea, seems to establish the fact that this underlying prostatic sclerosis is not necessarily gonorrheal, but may be due to the congestion of sexual excess or of continence, to gonorrhea, or simply to advancing years. Where chiefly to lay the blame we do not know; in the meanwhile let charity temper our provisional conclusions.

It seems probable that whatever conclusion is reached in this obscure matter will be based upon the fact that the prostate tends to undergo retrograde changes with cessation of its sexual function, as do the uterus and the female breast. How far prostatic hypertrophy will be found attributable to this normal involution, and how far the congestion of sedentary life, to the inflammations of youth, and to the congestion of sexual excess, the future must determine.

MORBID ANATOMY

Microscopic Changes.—There are three general types of hypertrophied prostates—a diffuse, soft, "adenomatous" type, a diffuse, hard, fibrous type, and a type characterized by the growth of encapsulated tumors within the gland. No given example of hypertrophy adheres strictly to any one type; indeed, it is the rule to find all three types existing in different parts of the specimen: in one place a diffuse,

[1] *Jour. Am. Med. Ass'n*, 1904, XLIII, 187.

soft enlargement, in another dense masses of fibrous tissue, and scattered everywhere enucleable tumors, large and small, the larger ones (Figs. 59, 60) complex in structure.

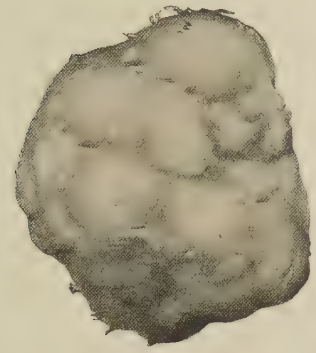

FIG. 59. — ADENOMA ENUCLEATED FROM A HYPERTROPHIED PROSTATE.

FIG. 60. — SECTION OF A LARGE PROSTATIC ADENOMA, SHOWING ITS COMPOSITE CHARACTER.

These changes are due, as we have seen in the preceding paragraphs, to chronic interstitial fibrosis of the prostate; and however descriptive the terms adenoma and fibroma may be in this connection, we must remember that in using them we do not refer to true neoplasms, but to the pseudo-neoplasms resulting from inflammation of the gland and obstruction of its ducts.

To describe the various changes encountered in the tissues of the hypertrophied prostate would require pages of pathologic detail, interesting only to the special student, and already accessible in the works of Ciechanowski, Greene and Brooks, and Crandon.

Diffuse Soft Hypertrophy.—This represents a general distribution of obstructed ducts and of dilated ducts and acini. The cut surface is soft and bulging, dotted with cystlike spots filled with hard, yellow concretions, or softer, inspissated prostatic secretion. The microscope shows ducts and alveoli widely dilated, their epithelium flattened, their lumen filled with desquamated epithelial cells and detritus, sometimes with pus. Careful examination of serial sections often reveals the point of constriction where a duct is strictured by interstitial infiltration about it and dilated beyond.

Fibrous Hypertrophy.—Here the cut section is hard and fibrous, though scattered traces of soft hypertrophy may be seen. The microscope shows masses of scar tissue, into which the soft "adenomatous" tissue has been transformed by inflammation. Clinically, therefore, fibrous hypertrophy may be regarded as "adenomatous" hypertrophy scarred by prostatitis.

Pseudo-adenoma.—The pseudo-adenomata so constantly found in the aged prostate, whether hypertrophied or not, are due to the excessive dilatation of a large duct which, running normally in a curve and forced to increase this curve as it enlarges, finally almost completely encircles a portion of gland tissue which has undergone soft, hard, or, as in Fig. 59, pseudo-adenomatous hypertrophy.

Macroscopic Changes.—Inasmuch as the hypertrophy may concern any or every part of the organ, a number of varieties of hypertrophy exist and may be tabulated as follows:

		Thompson.[1]	Prédal.[2]	Desnos[2].	Motz.[3]	Watson.[4]	Total.
Total hypertrophy.	General	74	7	17	8	14	120
	Notably median	19	23	..	1	..	43
	Notably lateral	..	..	..	5	..	5
	Notably unilateral	19	..	5	2	..	26
							194
Partial hypertrophy.	Lateral only	5	15	12	10	4	46
	Anterior commissure only	3	..	..	..	..	3
	All but the median lobe	3	..	..	..	..	3
	Median only	..	19	14	..	9	42
	Median and unilateral	..	..	..	1	2	3
	Pedunculated tumor	..	..	..	..	1	1
							98
		123	64	48	27	30	292

This table shows that all parts of the gland were involved in 65 per cent of the cases, while at least one lateral lobe was enlarged in 84 per cent, both in 83 per cent. Hence, in 84 out of every 100 cases the prostatic enlargement may be diagnosed by rectal touch. My own clinical observation would lead me to put the percentage even higher. Desnos's cases of hypertrophy ranged in weight from 23 to 85 grams (the normal prostate weighs 20 grams). Much larger tumors are occasionally met with, but in the usual run of cases the prostate is much smaller than a mandarin orange.

The most notable changes associated with hypertrophy of the prostate are (1) bulging of the posterior surface of the gland, (2) elevation of the urethral orifice, (3) production of a middle lobe, and (4) lengthening and distortion of the prostatic urethra.

1. **Posterior Enlargement.**—We have seen that in a large proportion of cases the lateral lobes of the prostate are enlarged. Such an enlargement may always be felt by rectal touch. The examining finger, instead of impinging upon a scarcely perceptible organ, encounters a large

[1] *Op. cit.*, p. 39.
[2] Desnos, "Maladies des voies urinaires," 1898, p. 386.
[3] *Op. cit.*
[4] "Operative Treatment of the Hypertrophied Prostate," 1888.

mass, perhaps the size of a plum or a mandarin orange, perhaps so much enlarged that its upper border cannot be reached. To estimate the size of the growth the finger is swept over it from side to side, into the sulci between it and the lateral wall of the rectum, and, if possible, over the top of the tumor. Its projection may thus be fairly estimated and its general character of elasticity or hardness determined. In shape the mass is usually quite globular. It may be furrowed down the center, showing that the overgrowth has chiefly affected the two lateral lobes, but has spared the posterior commissure. One lobe may be more hypertrophied than the other. Small phleboliths may be felt upon the gland, or hard nodules within it.

FIG. 61.—BILATERAL HYPERTROPHY OF THE PROSTATE WITHOUT MEDIAN ENLARGEMENT.

FIG. 62.—GENERAL HYPERTROPHY OF THE PROSTATE, THE MEDIAN AND LATERAL LOBES FORMING A SINGLE MASS.

2. **Elevation of the Urethral Orifice.**—When bladder and prostate are normal, the urethral orifice practically lies on the same level as the trigone and the floor of the bladder. But every form of prostatic hypertrophy disturbs this relation. If the growth is purely lateral, whether on one or both sides, the tumor lifts a fold of mucous membrane at the urethral orifice (Fig. 65). If there is general hypertrophy, the posterior commissure projects upward into the bladder, pushing the urethra before it and forming the so-called *bar*

at the neck of the bladder (Figs. 66, 67). The *third lobe* (Fig. 68) acts in the same way. Finally, the chronic posterior urethritis, so often met with in this disease, may cause a true *contracture of the neck of the bladder* (p. 325), with increased elevation of the urethral orifice.[1]

FIG. 63.—GENERAL HYPERTROPHY OF THE PROSTATE, WITH RELATIVELY SLIGHT MEDIAN ENLARGEMENT IN THE FORM OF A BAR.

In order of clinical frequency the causes of elevation of the urethral orifice are: (1) Bar and contracture with about equal frequency, (2) the third lobe, and (3) rarely, the lifting of the orifice between lateral projections.

3. **The Third or Middle Lobe.**—This term is loosely used to indicate any projection into the bladder, be it bar or tumor. Properly speaking, the middle lobe of the prostate is a distinct outgrowth from the neck of the bladder or from the floor of the prostatic urethra (Fig. 64). This tumor springs from the posterior commissure of the gland, and was supposed to originate within it. But Jores[2] showed that "its first beginning occurs

FIG. 64.—PEDUNCULATED MEDIAN ENLARGEMENT.

[1] Rochet ("Traité de la dysurie sénile," Paris, 1899) gives some space to the consideration of those unusual forms of hypertrophy in which the upper lobe is chiefly affected, and there is no elevation of the urethral orifice. Such a case was also illustrated in the previous edition of this treatise.

[2] *Virchow's Archiv*, 1894, CXXIX, 224.

in the accessory prostatic glands which lie just under the mucous membrane, and the projection into the bladder is due at first to the hypertrophy of these alone." Later, the hypertrophy of the pars

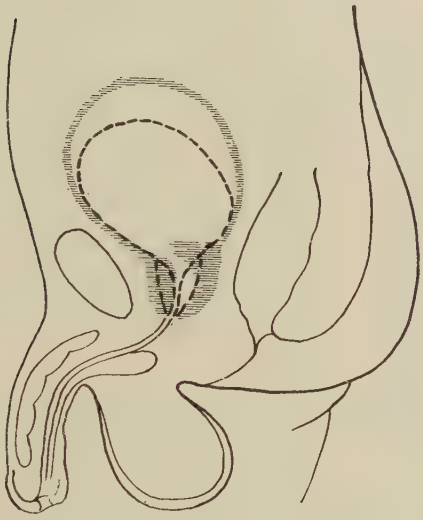

FIG. 65.—SAGITTAL SECTION OF FIG. 61.

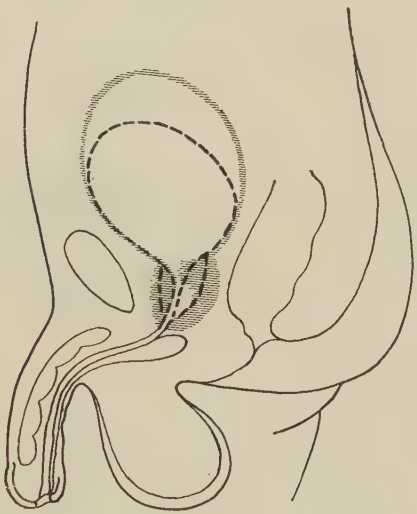

FIG. 66.—SAGITTAL SECTION OF FIG. 62.

FIG. 67.—SAGITTAL SECTION OF FIG. 63.

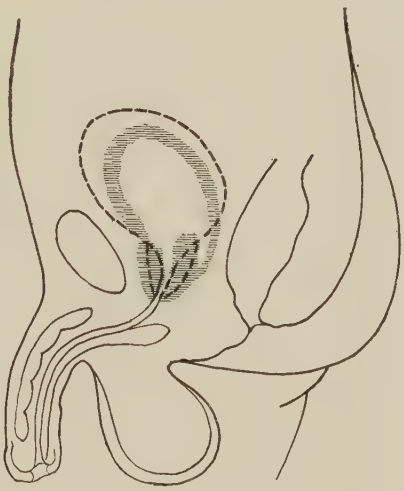

FIG. 68.—SAGITTAL SECTION OF FIG. 64.

FIGS. 65–68 REPRESENT THE OBSTRUCTIVE CONDITIONS PRESENT IN PROSTATISM. NORMAL BLADDER AND PROSTATE IN DOTTED LINES. PATHOLOGIC CONDITIONS IN STIPPLE. Twice the bladder was thinned and dilated, twice concentrically hypertrophied.

intermedia usually forms the base of the tumor with the third lobe as its apex. These outlying glands are usually situated at the urethral orifice

"directly beneath the mucous membrane and between the circular fibers of the bladder and the middle isthmus of the prostate" (Alexander [1]). There are a few similar glands lying along the floor of the urethra, and occasionally these become hypertrophied and form projections in the floor of the urethra itself. The middle lobe is rarely more 2 cm. in diameter. It will be observed that some median enlargement is noted in 81 per cent of the tabulated cases.

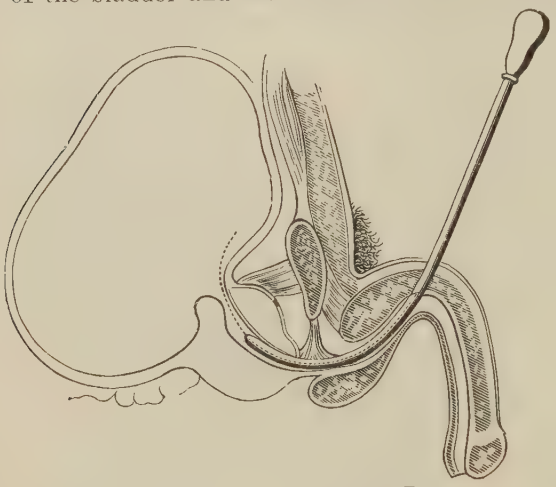

FIG. 69.—SECTION OF HYPERTROPHIED PROSTATE. Compare urethral curves in Figs. 69 and 70.

4. **Lengthening and Distortion of the Prostatic Urethra.**—The prostatic urethra is altered in length, size, and curve (Figs. 65–70). *The urethra is always lengthened* by the increased size of the prostate, whether the hypertrophy be general or circumscribed. But the lengthening of the canal is not very great, unless there is a middle lobe or a prostatic bar to be surmounted before the bladder is reached. This is an important point in relation to prostatectomy, since a long urethra means that a great deal of tissue must be removed to enable the bladder to empty itself, while, if the urethra does not exceed 21 cm. (8½ inches) in length, a mere incision with the cautery will set things right in most cases (p. 323).

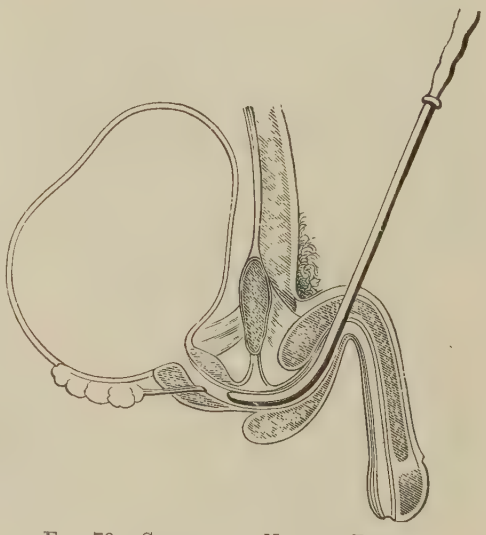

FIG. 70.—SECTION OF NORMAL PROSTATE.

The urethra is dilated chiefly by the growth of the lateral lobes which enlarge on each side of it and spread it out on a vertical plane, so that,

[1] *Med. Record*, 1899, LVI, 982.

from being a transverse slit, it is altered to a vertical one, with perhaps a curve to one side or the other, where a projection in one lobe fits into a depression in its fellow of the opposite side. The dilatation may be so great that an ordinary sound can be rotated quite freely within the canal, thus giving the false impression that the bladder has been reached. *The curve of the urethra is lengthened.* That is, its internal orifice is carried upward and backward, and the canal, instead of having the short normal curve, sweeps in a curve of much longer radius, a curve that will not transmit the ordinary steel sound, but requires special instruments with the long prostatic curve (Fig. 70). The urethra is further deformed by the presence of the bar, behind which the canal forms a distinct pouch, or by the projection into it of tumors from the various lobes, notably the middle lobe, which sometimes blocks the way completely after the fashion of a ball valve, or may allow the urethral current to flow in one or two streams at either side of its base.

Pathological Physiology and Secondary Morbid Changes

Retention, Congestion, Inflammation—these are the Fates of the prostatic.

Retention.— The causes of retention of urine are to be found both in the prostate and in the bladder. The prostate is primarily at fault. I do not remember to have seen retention of urine, whether complete or incomplete, in any prostatic who had not some obstruction at the neck of his bladder, some elevation of the urethral orifice (whether such elevation was absolute or merely relative to the bladder), by bar, middle lobe, or contracture of the neck of the bladder. These changes about the urethral orifice disturb its physiological relation to the bladder. When in the act of urination the bladder contracts, it forces the urine over the prostatic bar with great difficulty; it is overstrained. To estimate the effects of this strain, the condition of the bladder at this time of life must be borne in mind. In the child the organ is ovoidal with the sharper end at its neck; it has no floor. But as adult life is reached it settles down into the pelvis. Its trigone becomes more and more horizontal. It acquires a floor. As age advances it tends to sag more and more. In the female it bulges down until it forms a cystocele. But in the male the bladder neck is supported by the urethral and prostatic attachments to the pubes, and, as the bladder sags, it thus tends to pouch behind the prostate, the trigone swings around until it forms the anterior incline of this pouch—the *bas fond*, as the French call it. While there may be some *bas fond* without prostatic hypertrophy, without obstruction of the urethra, such a *bas fond* has no clinical significance. But when there is urethral obstruction, with an extra strain upon the bladder, and heightened vesical tension at a time of life when

the muscles are becoming fibrotic and losing their energy, the result is a relatively rapid pouching of the floor of the bladder, a general weakening of its muscle, and an inability of the organ to empty itself completely. The *bas fond* is never dry; there is always some urine left in the bladder; in short, there is *partial retention* of urine. It is as though the bladder were a tank with the outlet upon one side instead of at the bottom. However often the water is allowed to drain off from the tank none of its contents below the level of the outlet pipe can escape and the tank cannot be completely emptied.

As a result of this vesical derangement, and because of the low vitality of its dilated and inflamed parenchyma, the prostate, perhaps still bearing the scars of ancient battles with the gonococcus, is very subject to attacks of *acute congestion.* A Christmas dinner, an exposure to cold, particularly of the legs, a slight alcoholic excess, may bring on acute congestion in a prostate that has given no previous trouble. The patient may have had a little retention of urine quite unconsciously, until some day his acute congestion comes and he cannot pass water. Perhaps he succeeds in relieving himself by dint of hot baths and straining; perhaps his urine has to be drawn from him. The attack may be lasting, or transitory, it may or may not terminate in inflammation; in any case, it causes a temporary *complete retention of urine*, increases the chronic partial retention, and enhances the effects of this retention upon the upper urinary organs. And the constant pressure of the retained urine produces in turn a *chronic congestion* of the prostate.

The Bladder.—The bladder changes due to retention are all of an evil character, though some of them have the appearance of compensatory hypertrophy. Infection plays so large a part in these changes that they are better grouped with the lesions of urinary infections (p. 335).

The Ureters and Kidneys.—After the bladder has begun to feel the effects of its futile struggle, and is undergoing the changes just noted, the upper urinary organs feel the distention. The ureters begin to dilate, first at their vesical orifices, then higher and higher up. In places they attain two and three times their normal size. Next, the renal pelvis, with the surrounding kidney substance, gives way before the ever-increasing pressure. A hydronephrosis or a pyonephrosis is established, and the renal parenchyma slowly and silently atrophies.

CHAPTER XXVI

SYMPTOMS, DIAGNOSIS, AND PROGNOSIS OF PROSTATIC HYPERTROPHY

SYMPTOMS

The cardinal symptoms of prostatic hypertrophy are *frequency of urination,* chiefly by night, *difficulty in urination,* and *dribbling* from overflow, irritation, or incontinence.

Frequency of Urination (*Pollakiuria*).—*Nocturnal frequency of urination* is almost pathognomonic of hypertrophy of the prostate. That the urine is passed too often is due to the congestion of bladder and prostate, which, as a rule, makes them sensitive to a less distention than when in their normal state. Increase in local irritability plays the chief part in causing this pollakiuria.

Nocturnal polyuria is in no way related to the question of residuum. The nocturnal polyuria, which these cases also often manifest, is more an evidence of failing vital force than of dilatation or congestion of the kidney. Indeed, congestion of the kidney is more likely to produce diminution than increase of urinary flow. The polyuria, if present, seems to be uniformly distributed throughout the night; not so the pollakiuria, of which a distinct feature is its tendency to increase toward morning. The urinary intervals shorten as the night wanes, so that, while the early hours of the night may be passed in comparative comfort, the morning hours are constantly disturbed.

Diurnal frequency is at first represented only by the repeated efforts necessary to empty the bladder when the patient arises for the day. Later, when the residuum rises, or infection supervenes, urination becomes frequent throughout the day, perhaps even more frequent than at night.

Difficulty in Urination (*Dysuria*).—When there is prostatic obstruction the act of urination is generally tedious, difficult, and even painful. This prostatic dysuria has four striking features:

1. The stream is very slow to start. Sometimes the sufferer struggles several minutes before his water will come.

2. The flow lacks force and body. There is no gush of water. It comes in a thin stream, the jet is not great, perhaps it only dribbles forth drop by drop.

3. The greater the strain the less the result. Patients themselves often remark that the more anxious they are to hurry the less they succeed. Their predicament is almost that of the young neurotic subject, to whom any hurry in urinating is an absolute preventive.

4. At the end of the act there is no sharp piston-stroke finish. The urine dribbles away by irregular jets and drops, and the act might be said rather to fade away than to terminate.

The amount of *pain* on urination and general uneasiness in the intervals depends upon the amount of congestion and inflammation.

Dribbling.—Of all the symptoms of prostatic hypertrophy, a constant dribbling is the source of greatest discomfort. Many other symptoms disturb the patient more acutely, but none is more constantly annoying. This dribbling may be due to three widely differing causes:

1. **Overflow.**—When there is complete retention the bladder fills until it can hold no more. Then, instead of bursting, it overflows. The mere elasticity of the bladder wall finally overcomes the obstruction and urine drips away from the meatus at about the same rate at which it arrives in the bladder. The bladder remains full. There is no true incontinence. There is simply a continuous overflow.

2. **Irritability.**—In many cases, with but little residual urine, there is constant dribbling, not from overflow, nor yet from true incontinence, but due to irritability of the bladder, whereby every few moments a drop or two of urine is expelled. This condition is rather an abnormal frequency of urination than an incontinence, since the urine does not drip away in spite of every muscular effort to control it, but is constantly expelled by a muscular spasm.

3. **True Incontinence.**—This is extremely rare. The patient has persistent dribbling of urine suggesting overflow. But his urethra readily admits a catheter and his bladder is found to be empty. This is true incontinence. It seems due to a distortion of the urethral orifice in such fashion that the sphincter cannot close, so that the urine is allowed to flow from the bladder as fast as it enters.

COURSE OF THE DISEASE

The patient may date the beginning of his troubles from an acute retention, from a tendency to dribble between the urinary acts, or, less frequently, from a hematuria. He may have simply noticed an increasing frequency and difficulty in urination; but close questioning will usually show that the malady has passed through three stages: 1. The stage of congestion without retention. 2. The stage of partial retention. 3. The stage of retention with overflow. The second and third

stages may be introduced or interrupted by attacks of acute complete retention.

1. **Congestion.**—During a period of many months, perhaps years, ever since there began to be a little hyperemia around its neck, the bladder has been gradually becoming irritable. The patient does not readily notice this, and will never be able to fix a precise date for the commencement of his troubles. An old man does not sleep soundly nor pay the strictest attention to the performance of his habitual functions, and he so gradually acquires the habit of getting up a little earlier than usual in the morning to empty his bladder that he pays no attention to it. Soon he finds that he wakes up once at night, perhaps twice, with a feeling of fullness in his bladder. He passes water, and goes to sleep again. He is also troubled in the daytime a little more frequently than usual, but he looks upon this as a condition natural to advancing life. He has learned that the little ills of the flesh, if let alone, usually regulate themselves. He has passed water without trouble for fifty or sixty years, and he thinks that he ought still to be able to manage it without applying to the surgeon. He shrinks from acknowledging a weakness, which he must admit to be, if nothing more, a symptom of advancing age, and so he goes on lulled to security, making water at intervals which gradually, but steadily, become shorter, and constantly annoyed by a faint, obscure sense of weight and heaviness about the lower part of his belly, with, perhaps, a fullness in the rectum, and a dull pain behind the pubes. During this first period of the disease attacks of neuralgia of the neck of the bladder and surface prostatitis may occur from insignificant causes, and a sexual irritability almost amounting to priapism may prove very annoying.

2. **Partial Retention.**—The passage from the first to the second stage of the disease, unless marked by an acute retention, is quite insensible; but ultimately the time arrives when the *bas fond* is formed and the bladder is no longer quite able to empty itself; only an excess above a certain residuum can be passed off, but the patient does not know it. He only notices that his urinary intervals are getting shorter and shorter; that he has to wait a little before the urine begins to flow; that the stream is small, and is not projected away from him with any force, and that, perhaps, a part of the urine dribbles down perpendicularly from the meatus, while the rest flows as a continuous stream; he does not experience quite so much ease and relief as usual after micturition. But this has come on so gradually that he disregards it. He may notice the return of morning erections, which had long since ceased to trouble him.

During all this while the amount of residual urine is imperceptibly increasing toward total retention. This increase may be interrupted at any time by an attack of acute retention.

Acute Retention.—At this juncture the patient dines out, and drinks a glass or two of wine, or he neglects a call to urinate, or gets a wetting, or his feet and legs get chilled (this is the commonest cause of trouble), and suddenly he finds that he cannot pass water at all. After vainly trying at intervals for a number of hours, if he does not seek relief, at last the urine will begin to dribble away from him. The bladder has been distended to its utmost, the mouth of the urethra has been dragged slightly open, and the excess of urine trickles away involuntarily. This is overflow and not incontinence. Meantime the patient has been suffering the torments known only to those who have had retention, and he hails the overflow with delight, believing that his sufferings are about to cease. The hope is vain. The congestion of the bladder neck, brought on by the use of liquor, or by the chilling, and which, added to the already large prostate, has swollen it sufficiently to shut up the urethra entirely, may subside spontaneously, or be relieved by the catheter, leaving the patient little worse off than before, but it is more likely to continue, thus leading to the third stage of the disease.

During the stage of incomplete retention pressure begins to be exerted upon the kidneys; polyuria, especially by night, may be added to the nocturnal pollakiuria.

3. **Complete Retention.**—Now the bladder is literally full all the time. During the day the patient may be able to prevent a continuous overflow by urinating a few drops every ten or fifteen minutes; but at night, at least, the bladder is quite unable to cope with the inflow of urine, which therefore dribbles away, disturbing the patient's rest and adding shame to his other sufferings.

By this time the ureters and their pelves have begun to dilate and the kidneys to atrophy. The polyuria becomes considerable. Two, three, or four quarts of urine are passed, chiefly at night, of a specific gravity of from 1.005 to 1.010, containing a very low percentage of urea and salts. There is a general urinary toxemia. The tongue is dry, glazed, and red at the edges, brown or gray in the center. The appetite is poor, the bowels constipated and full of gas. The patient loses flesh and becomes feeble and worn.

Variations in the Course of the Disease.—While the above description applies to many cases, the progress from one stage to the next may not be so systematic. Appropriate treatment may carry the patient back from the stage of partial retention to that of mere congestion, or from complete back to partial retention; or an isolated acute retention may be relieved and be followed by a long interval, even an interval of several years, during which the patient suffers not at all, and there is no retention whatever.

The *inflammatory complications* are, however, the chief agencies in modifying the course of the disease. These complications occur sooner

or later in every case, and once the inflammation has set in it is almost impossible to get rid of it. *The inflammation is usually due to catheterism.* Spontaneous infection does occur, but, as a rule, the complication is due to the surgeon's misfortune or fault.

Inflammation of the Prostate.—*Chronic prostatitis* is always present in every infected case; indeed, the posterior urethra and the neck of the bladder are the places from which it is least possible to dislodge the inflammation. *Abscess and periprostatitis* are relatively uncommon. *Seminal vesiculitis* is common and usually unimportant.

Epididymitis.—Epididymitis may occur in acute attacks, spontaneous or following instrumentation, or it may appear as a sluggish, chronic induration at one end of the epididymis, with occasional subacute or acute attacks of recurrent inflammation. The epididymitis of the prostatic is especially prone to suppuration.

Cystitis.—Inflammation of the bladder is the most common and important complication of prostatic hypertrophy. The cystitis is usually due to catheterism, less frequently it is spontaneous. When due to the catheter, it usually begins acutely, often with a chill, while spontaneous cystitis is commonly chronic from the outset. Although the type of the inflammation may be severe throughout, the cystitis of prostatics is often of a mild and superficial type for many months, not causing any great pain or frequency of urination, or, at any rate, easily controlled by local treatment. The cystitis may be alkaline or acid.

Pyelo-nephritis.—No prostatic can have cystitis for any length of time without extension of the inflammation up the ureters to the kidneys. The urinary stasis permits the bacteria to work up against the current, and the kidneys—already partly disabled—fall an easy prey to the bacterial invasion. The pyelo-nephritis often remains for years a mild catarrhal inflammation, recognizable only by a careful urinary examination; but, mild as it is, this inflammation is an aid to the urinary pressure in its work of debilitating the kidneys and slowly leading to the patient's death.

Stone.—Phosphatic stone is the natural result of ammoniacal cystitis.

One stone, or several, may exist under these circumstances without giving rise to any symptom. They are usually smooth, and do not greatly irritate the floor of the bladder, nor add much to the already existing pain. The bladder often cannot, during micturition, force a stone thus formed against the sensitive tissues at the neck of the bladder and produce the striking symptoms which characterize vesical calculus without prostatism.

Yet stone always adds to the diurnal frequency of urination and to the vesical irritability.

DIAGNOSIS

Rectal Examination.—When a patient over fifty years of age comes to seek relief for frequent micturition, suspicion falls at once upon the prostate. It is rare that stricture causes trouble for the first time so late in life, and even rarer for prostatic retention to occur earlier; moreover, with enlarged prostate, the inconvenience will, as a rule, have been first noticed at night—the reverse of what is observed in stricture. As the first step in the examination, a digital exploration should be made through the rectum. By this means alone prostatic hypertrophy can almost always be demonstrated. In place of the soft, chestnutlike body, hardly recognizable except by the skilled touch, the finger encounters a rounded, dense mass, smooth and usually symmetrical. The median fissure between the lobes may be more than usually perceptible, or may be wholly obliterated; while the finger passed up on each side, between the prostate and the walls of the pelvis, recognizes a deepening of the sulcus, and any undue prominence in size of one or the other lobe. By forcing the finger well up the rectum, it may be possible to hook the last phalanx above the posterior margin of the enlarged prostate, where the seminal vesicles can sometimes be made out on each side, well above the hypertrophied prostate.

If only the median lobe is hypertrophied, rectal examination may reveal no positive evidences of this enlargement. In such a case the finger readily detects the bladder, if it be distended, beyond the prostate; the latter apparently not at all or but little larger than normal. Pressure through the rectum upon an enlarged prostate does not cause pain, unless there be some inflammation about the neck of the bladder, but it often provokes a desire to urinate.

Hypogastric Palpation.—The next step in the examination is to make out the condition of the bladder by palpating and percussing the hypogastrium. Usually this gives no hint of the condition of the prostate, unless it is exceedingly large, when pressure upon it through the rectum may be recognized by the hand upon the hypogastrium. (This same resistance may be felt in marked concentric hypertrophy of the bladder.) As a rule, hypogastric palpation only excites a desire to urinate from transmission of the force to the sensitive neck of the bladder. But if the bladder is distended with urine, an oval tumor is found, filling up the lower part of the belly, perhaps as high as the umbilicus, flat on percussion, and causing a desire to urinate when pressure is made upon it. This tumor, formed by the overdistended bladder, may sometimes be plainly seen, but the patient is usually unconscious of its existence. If the finger in the rectum can reach beyond the posterior border of the prostate, fluctuation can be felt between it and the other hand pressed upon the hypogastrium.

The Urine.—The patient is now asked to stand up and to pass water into a glass vessel. As the urine flows the sluggishness of the stream is noted.

If there is complete retention, the urine will not flow at all, or comes only by drops. While the stream is flowing, if the patient be told to strain, instead of becoming larger or flowing with greater force, it may be diminished in size and power. If the bladder be inflamed, there may be severe tenesmus and pain during the attempt to urinate, and the rectum may protrude or feces be passed during the act. Hernia may be occasioned by the violent straining. At the end of urination the stream gradually dribbles away in drops, and often the final jet is wanting, although this may be perfect or even exaggerated.

If the urine be now held up to the light, its cloudiness or limpidity will prove an index to the presence or absence of urinary infection.

In examining a patient for the first time it should never be lost sight of that he is an old man whose urinary passages are in an irritated condition, and unused to local disturbance. Any examination at all rough or too prolonged is pretty sure to be followed by infection, and, unless the condition be urgent (retention), it is often advisable to make only a partial exploration at the first sitting, leaving the rest for another day. If, however, there is retention, it becomes the physician's duty to make judicious use of all available means to enter the bladder with a catheter. But such persistence is justifiable only for the purpose of relieving the patient's retention, not for diagnosis.

Catheterism.—When the patient has voided all the water he can, he is placed upon his back, and a soft-rubber catheter (17 F.), previously sterilized, is gently introduced into the bladder. If it will not enter, a woven catheter, of the elbowed or double-elbowed pattern, is sterilized and introduced. No force should be employed in introducing these instruments. Dexterity and patience will succeed where brute force will only light up inflammation or open a false passage. The elbowed catheter is especially designed to ride over the prostatic obstacle, and can almost always be introduced, if properly and patiently manipulated, and aided by a finger on the perineum or in the rectum, unless there is a stricture of the urethra, which arrests the catheter before it reaches the prostate, or unless the hypertophied organ has been damaged by previous rough attempts at catheterization.

If, after very gentle urging, the elbowed instrument fails to enter, no further instrumentation should be attempted. The patient should be sent home to begin his course of urotropin.

When the catheter reaches the bladder the urine jets from it. The *atony* of the bladder may be estimated by the force of the stream. If atony is complete, and the patient recumbent, no urine may issue from the catheter, even though the bladder be quite full. Pressure on the

hypogastrium, or catheterization in the erect position, will start a sluggish stream.

The amount of residual urine measures, in a general way, the amount of retention, though this must be repeatedly verified.

The urethral length is also measured by the catheter.[1] One usually feels the resistance of the cut-off muscle very plainly in entering, and if the urethral length is not increased, one looks to strike water 5 to 6 cm. beyond. If the cut-off is not felt, one measures the total urethral length upon withdrawing the catheter. On account of the variable length of the anterior urethra the latter method is the less reliable.

In thus emptying the patient's bladder two rules must be borne in mind:

1. *Close the operation by a mild antiseptic irrigation*, with permanganate of potassium (1:6,000), or nitrate of silver (1:8,000).

2. *If the bladder retains more than* 1,000 *c.c., the patient must lie down while his urine is being drawn, and the bladder must be immediately refilled to one half its former capacity with boric-acid solution.* Neglect of this precaution has caused syncope and instant death. A more common result from the sudden relief of pressure is an acute congestion, which may terminate in profuse hemorrhage (*hematuria ex vacuo*) or in cystitis.

After the first passage of the catheter the patient should remain warm and quiet, but not necessarily in bed, for some hours—preferably for an entire day.

Further discussion of this subject, notably of the dangers of urinary fever and cystitis after catheterization, is deferred to the chapter on Treatment.

Cystoscopy.—None but a specialist in urinary surgery should attempt cystoscopy in cases of prostatic retention. The operation is dangerous to the patient and is calculated to give little information to the unskilled manipulator. But to the specialist, cystoscopy is of the greatest service. It permits a more thorough appreciation of introvesical conditions than is attainable by any other means; it searches for stone much more thoroughly than does the stone searcher; it permits ureteric meatoscopy, and, in most instances, ureteral catheterism (if required). It also gives a very fair estimate of the form of the prostatic obstruction. This subject has been thoroughly worked up by Young, from whom the accompanying illustrations are borrowed.

Cystoscopy, in a case of prostatic retention, should be performed only for the purpose of the diagnosis of stone, or as a preliminary to operation. For the diagnosis of stone it is required in all infected cases.

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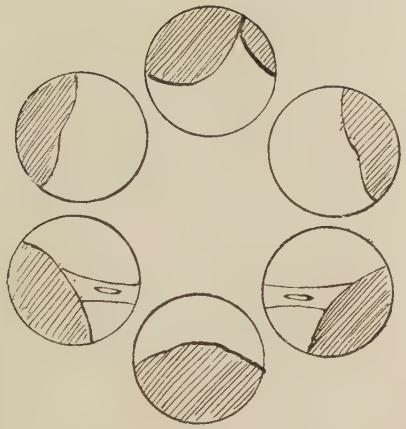
[1] Special instruments devised for this purpose, such as those of Hagner and Cunningham, are not generally useful.



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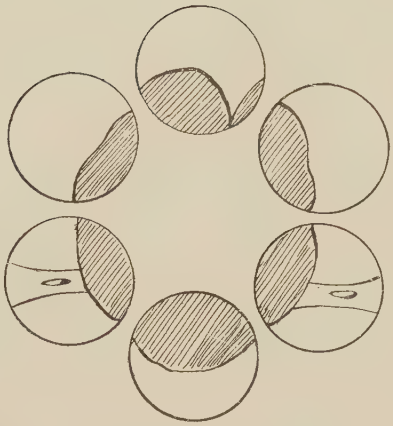

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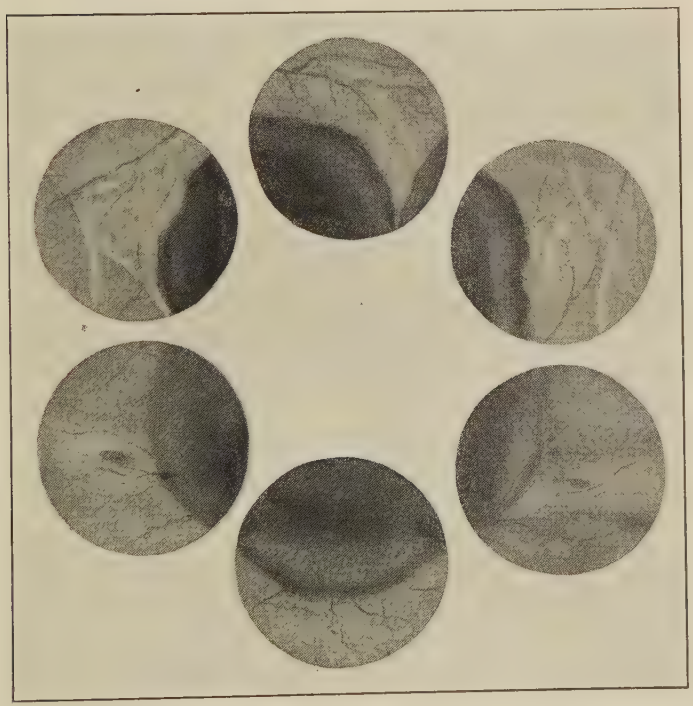

3

CYSTOSCOPIC INTERPRETATION OF THE APPEARANCE OF THE BLADDER NECK IN PROSTATIC HYPERTROPHY.

FIG. 1.—General prostatic hypertrophy, middle and lateral lobes forming one mass—as seen by the cystoscope.

FIG. 2.—Schematic interpretation of Fig. 1.

FIG. 3.—The actual condition.

The introduction of the instrument may be exceptionally difficult on account of the prostatic obstruction, but this may almost always be overcome by marked depression of the ocular extremity of the instrument.

To examine the prostate with the cystoscope, it is best to begin at the base of the bladder, with the instrument turned upside down, and to withdraw it slowly until the prostate comes into view. This appears rather as a velvety, pinkish, rounded body, than as the dark shadow of the normal bladder neck. Having identified the prostate, one turns the cystoscope in a circle, stopping eight times on the way around to observe (and to jot down) the picture seen. The illustrations given herewith indicate very well the usual conditions found. Young insists on the advantage of interpreting the pictures, turning them inside out as it were, and the illustration shows the result; but, inasmuch as the pictures are always seen in the same way, it is to my mind quite as convincing to represent them as seen.

The reason for beginning the examination at the base of the bladder is that the middle lobe or bar usually projects as far as any part of the prostate and often much farther. As we come around to the side, the cystoscope is drawn out quite a little to see the lateral lobes or the lateral walls of the bladder neck, and has to be pushed in again whenever any further projection is encountered. The size of the lobes one appreciates as much by this excursion of the instrument in and out as by the graphic curve. The cystoscope employed is, of course, the prismatic instrument; the various retrograde cystoscopes are unnecessary and have found no general favor.

The Searcher.—The stone searcher must be employed for the diagnosis of stone by those who are unfamiliar with the use of the cystoscope, and in all cases when cystoscopy is impossible. It is by no means a reliable instrument, since a stone behind a prostate considerably enlarged, or in a diverticulum, entirely escapes the searcher. To outline the shape of the prostate with the searcher probably requires much more skill than to do so with the cystoscope. Cathelin has devised a very ingenious instrument for this purpose, the necessity for which is not obvious.

Urinalysis.—Inspection of the urine is always part of the examination. It bears chiefly upon the presence of pus and the general characteristics suggestive of pyelo-nephritis. The twenty-four-hour specimen should, of course, be submitted to routine examination, and the division of this twenty-four-hour specimen into day and night is of great service in estimating the presence of nocturnal polyuria.

Other Methods of Examination.—According to the information obtained by the foregoing examination, we examine the patient still further—palpate the kidneys, submit him to X-ray or ureteral

catheterism, or to various therapeutic tests that may be required before one can absolutely determine the precise condition of all the renal organs. For the fact that the prostate is hypertrophied is of course the least important feature of the picture. The condition of the patient's bladder is more important than that of his prostate; the condition of his kidneys more important than either; the condition of his general health most important of all.

DIFFERENTIAL DIAGNOSIS

When a patient over fifty years of age comes to us complaining of nocturnal frequency of urination we mentally set him down as a prostatic. Yet the inference is by no means strict. Surely two out of five cases of nocturnal frequency are due to other causes, such as nocturnal polyuria, reflex irritation from the kidneys, prostatic carcinoma, or urethral neuralgia or stricture. The average prostatic begins to suffer between fifty-five and sixty-five, and first consults a physician at about the latter age. The patient who does not begin to suffer until after he is seventy years old usually has carcinoma. To add to the confusion, it is not to be forgotten that occasionally prostatic retention, due to bar or stricture at the neck of the bladder, occurs in young men twenty or thirty years before the prostatic age.

Careful physical examination rules out from the differential diagnosis such conditions as stricture, renal reflex, and nocturnal polyuria. But five conditions causing the symptoms of prostatism are very commonly confused. Indeed, it may for a long time be difficult in a given case to make the diagnosis absolute among them. These five conditions are:

Prostatic hypertrophy.
Prostatic neoplasm.
Stricture at the neck of the bladder.
Paralysis of the bladder.
Prostatic calculus.

Prostatic hypertrophy may usually be distinguished from the other four as follows:

Prostatic Neoplasm.—To distinguish prostatic hypertrophy from prostatic neoplasm always requires careful rectal examination, sometimes cystoscopy, and occasionally the test of time. It has been the fashion, of late, following the lead of Albarran and Hallé, to report as cases of beginning prostatic neoplasm those whose prostates, on removal, showed excessive intracanalicular, heaped-up epithelium, though, as Greene and Brooks and others have insisted, the malignancy is present only when the epithelial cells burst through the wall of the duct. Yet, even when put to this test, a certain number of cases apparently

suffering from simple prostatic hypertrophy prove to be neoplasms. Such microscopic neoplasms, however, often show no macroscopic evidence of their existence, and when once removed may be expected to do well, though of course the possibility of recurrence is to be borne in mind. The number of these cases is from 5 per cent (Greene and Brooks) to 14 per cent (Albarran) of all hypertrophied prostates.

A second class of cases have prostates the hardness of which is suggestive of malignancy. This hardness is diffused throughout one or both lobes. It is not nodular, and it does not extend beyond the limits of the lobe. No absolute criterion can be given to distinguish between simple hypertrophy and malignancy in these cases. The small, hard, inflammatory type of hypertrophied prostate feels quite as stony hard as any neoplasm. But this type of hard prostate usually shows two rather distinctive characteristics. It does not grow very large, and it is quite evenly bilateral. Neoplasm, on the other hand, does grow large and is usually unilateral. Exceptionally, however, the neoplastic prostate is soft and inevitably misleads the surgeon.

A third type of prostatic neoplasm is often mistaken for hypertrophy, but its physical characteristics should leave no room for doubt. The prostate is characteristically nodular. There is either a hard nodule in the body of an otherwise normal prostate, or else there is a diffuse hardness of a single lobe with several nodules upon it. Such cases should be X-rayed, to be sure that the nodules are not due to prostatic calculi. If the nodules are quite definite, quite hard, and lie within the prostate itself, they can scarcely be areas of simple inflammation.

Further advance of the prostatic neoplasm, showing itself as a typical neoplastic ridge extending from the prostate up to and involving the seminal vesicles, should leave no room for doubt. Pelvi-prostatic carcinosis and the ulcerating vesical or prostatic carcinoma should never be mistaken for hypertrophy.

While spontaneous hemorrhage is a symptom suggestive of malignancy, it is not altogether exceptional in simple hypertrophy.

Stricture at the Neck of the Bladder.—Pathologists have not yet told us where to draw the line strictly between inflammatory stenosis of the bladder neck and hypertrophic conditions causing a prostatic bar, which excites symptoms precisely comparable to those of stricture. In either event, the condition is prostatism without a prostate, as the French call it; i. e., prostatic retention without manifest prostatic hypertrophy. There may be retention of urine and the prostate be unenlarged to rectal touch, the urethral length being no longer than 20 cm. The cystoscope may usually be depended upon to determine the question. If there is definite thickening of the prostatic bar, it usually shows a rounded ridge with a little bulging in the center, but with gen-

eral elevation of the trigone, and even with apparent thickening running off toward the ureteric orifices. Stricture is more likely to show an apparently normal bladder neck, though this may be somewhat puckered and wrinkled, and is usually inflamed. Lacking the cystoscope, the diagnosis can only be made by operation.

Paralysis of the Bladder.—Before making the diagnosis of prostatism, the patient must be carefully examined for any spinal disease that might cause retention. Inasmuch as retention of urine is not infrequently one of the most marked early symptoms of tabes, it is especially important to test the reflexes and search the history with reference to this disease. Although most exceptional, it is by no means impossible for the tabetic to suffer from prostatic hypertrophy.

Prostatic Calculi.—Inasmuch as prostatic calculi may give no subjective symptoms at all, or may produce only a vesical irritability, while for objective signs they cause enlargement of the prostate, it is quite possible to mistake calculi for hypertrophy. Yet I have not known this to be done; indeed, the irregular outline of the prostate containing many calculi is usually such as to suggest neoplasm rather than hypertrophy.

PROGNOSIS

In the First Stage.—Inasmuch as the majority of slightly hypertrophied prostates give no symptoms at all, and an indefinitely large proportion of others give only slight symptoms for many years, one may be extremely optimistic about the prospects of the prostatic who is seen in the first stage of this disease.

About 50 per cent of prostatics have acute retention, and the great majority of these reach chronic complete retention within five or six years. On the other hand, I have followed one case fourteen years, from his single acute prostatic retention, and seen no return of symptoms. A number of other cases I have followed more than five years. The younger the case, the slower the average progress of the disease. The prostatic who begins to have symptoms at or beyond the age of seventy usually reaches chronic complete retention within two years.

In the Second Stage.—When the patient is in chronic incomplete retention, his prognosis is gradual failure of the bladder and passage to chronic complete retention more or less rapidly, according to his age, his infection, and other undetermined causes, such as the shape of the prostatic obstruction and the irritability of the prostatic urethra.

In the Third Stage.—When the patient has reached chronic complete retention, his expectation of life depends upon his ability and willingness to keep himself in good condition, either by systematic palliative treatment or by operation. The patient who neglects himself speedily comes to grief. The patient who takes care of himself may come to

grief by unavoidable accidents. But the passage of the catheter to empty a bladder in retention is not in itself necessarily fatal. Indeed, the patient who empties his bladder three or four times a day by means of the catheter is in no worse condition than the patient who empties his bladder the same number of times without a catheter, excepting only that the passage of the instrument is more or less irritating. In most cases, in spite of all our care, inflammatory complications occur in the kidneys that end fatally. Yet I know a number of men who have employed a catheter with entire satisfaction for more than ten years, and one of my patients has been in catheter life for more than forty years, and is at present in as good health as a man of eighty-three may justly expect to be.

Prognosis as Regards Infection.—The prostatic who constantly passes the catheter is doomed to infection in spite of whatever precautions he may take. Aseptic rules of catheterism are solely for the purpose of making this infection as mild as possible. The infection always occurs within a month or two, usually within a week or two, of the beginning of catheterism. We look for it and are happy to see it pass, since it establishes the patient in a condition which either is, or may usually be reduced to, a mild acid cystitis; and when once this infection is established, urinary antiseptics and bladder lavage often suffice to prevent any grave active infection thereafter, and sometimes even banish all appearance of infection from the patient's urine for long periods of time together.

The larger the prostate, the more likely is the infection to be difficult to control. Careful patients with paralyzed bladders and complete retention without hypertrophy of the prostate do much better, as a rule, than prostatics; for the hypertrophied prostate, especially if the gland is greatly enlarged, is a constant source of acute relapses.

Infection of the kidneys and ureters probably establishes itself at about the same time as infection of the bladder. It is quite as difficult to dislodge; but if the retention is well managed, so that the kidneys do not suffer much back pressure, it is usually easy to control.

Prognosis as Regards Kidneys.—Most prostatics who are not relieved of their retention by operation die by urinary septicemia with pyelo-nephritis. The issue may be rapid or slow. Watson [1] collected 207 cases of prostatism treated by the catheter, with a little less than 8 per cent mortality within a month. The estimate is not high, since fully 8 per cent of cases require operation within a month of the institution of catheter life, in order to save their lives. But the more usual danger from the kidneys is slow, insidious failure due to mild retention and mild infection.

[1] *Annals of Surgery*, 1904, June, p. 853.

CHAPTER XXVII

PALLIATIVE TREATMENT OF PROSTATIC HYPERTROPHY

The treatment of hypertrophy of the prostate is palliative and radical. Palliative treatment will be described first, while the detail of prostatic hygiene, which should be the background of every other treatment, demands preliminary consideration.

PROSTATIC HYGIENE

The prostatic man resembles the menstruating woman in that any exposure or overdoing reacts promptly upon his pelvic organs. "Beware of congestion" must be his motto, and upon this he must mold his life. He must avoid all exposure to cold: draughts are dangerous, wet feet fatal. His clothing, especially his underwear and footgear, must be regulated by the thermometer. Light exercise and fresh air are beneficial; but any excess—physical, mental, sexual, or alcoholic—must be avoided. Of alcoholic beverages, he may drink whisky, gin, and white wine in moderation; but preferably no beer or champagne. The stomach must not be overloaded. "*C'est souvent en lui souhaitant bonne fête,*" says Guyon, "*qu'on détermine chez un vieillard prostatique sa première rétention.*" The diet must be both light and laxative, for a torpid bowel threatens infection as well as congestion. Meats should be largely replaced by vegetables and cereals. Fruits should be employed circumspectly, as their acidity may do more harm than their laxative qualities do good. Finally, the patient must keep his urine bland by drinking plenty of water, using alcohol little or not at all, and cutting off all rich and fried foods. If he has been a high liver these dietary changes will have to be worked out gradually, since too great insistence on them all at once will only make him disobey instructions.

GENERAL TREATMENT

If the prostate is simply *congested*, the urine clear, the residuum negligible, there may be marked irritability of the bladder with frequent and painful urination. To conquer this, astringents and irritants may be useful. Tr. ferri chlorid (0.5 gram), *t. i. d.*, and hexamethylenamin

(0.5 to 1 gram), *t. i. d.*, sometimes allay the irritation, but local treatment is far more efficacious.

If there is *retention without infection,* the patient should be constantly on hexamethylenamin to prevent infection so long as any local treatment is being employed, and it is probably better that he should take a little of the drug at all times, if there is more than 50 c.c. of residuum.

If there is *infection,* the treatment is that of prostatitis or of retention cystitis, as the case may be. Hexamethylenamin is again the backbone of the treatment. It may be given for short periods of time in doses as high as the patient can bear, in the hope of controlling the infection. In connection with this drug the patient should drink enough water to keep his urine at or below a specific gravity of 1.012.

The treatment of renal infections is fully detailed in its appropriate place.

The bowels and stomach often require special attention by cathartics, vegetable and saline, enemata, gastric lavage, etc. When the local conditions have been righted the general health may be improved by tonics.

Opiates.—A final word on the subject of opiates. Hypertrophy of the prostate is a chronic disease, and pursues a most uncertain course. The sufferer, writhing in agony to-day, may be entirely relieved to-morrow. The patient whose last sun seems to have risen may be relieved by operation, and survive for many a year. Under these circumstances, it is scarcely necessary to insist that opiates should be administered with extreme caution. The patient, a constant sufferer from a tormenting disease, is in an ideal condition to become addicted to narcotics. I have seen few sadder cases than those of old men whose prostatic disease was still apparently curable, while their subjection to narcotics could not be overcome.

LOCAL TREATMENT

First Stage.—During the first stage of the disease the bladder empties itself completely. Catheterization is therefore quite unnecessary; indeed, it may be harmful. But there may exist, even during this stage, irritable bladder, which must be treated by instillations of silver nitrate, or by prostatic massage and the rectal douche. It is the relief of this condition, by the way, that is accomplished by the vaunted electrical, hydrotherapic and manipulative cures of prostatism. Or again, there may be prostatitis or cystitis, due to other causes (pp. 170, 332). Finally, an acute retention may be the chief feature of the disease, and this requires especial notice.

Acute Retention.—The urine must be withdrawn. Half-hearted measures are inefficient. The hot sitz bath may be employed with a

hypodermic injection of morphin as a temporizer; but the patient, once thoroughly obstructed, is quite beyond emptying his own bladder. The surgeon must do that for him.

If the rubber or woven catheter passes easily there are only two requirements: (1) Absolute cleanliness, and (2) evacuation of the bladder by easy degrees. Under the head of absolute cleanliness must be included irrigation of the meatus before catheterization, and washing the bladder afterwards.

As was stated in the last chapter, if the bladder in acute retention is found to contain more than 1,000 c.c. of urine, it may be emptied of no more than this amount. One may stop at 1,000 c.c., or may draw some 500 c.c. more and replace them with boric-acid solution. From three to six hours later 1,000 c.c. more may be drawn, and, if necessary, the same procedure repeated until the bladder is emptied. Continental practitioners prefer to leave an indwelling catheter after the first operation, and to perform the succeeding evacuations through this, but the procedure may as well be done by intermittent catheterism. In either case, the patient should be promptly put under the influence of hexamethylenamin by giving three 10-grain doses on the first day, and he should be kept as nearly as possible absolutely still, preferably in bed, during the first forty-eight hours after the first introduction of an instrument.

Second Stage.—1. **Simple, Uninfected Cases.**—The frequency of catheterization is theoretically regulated by the amount of residual urine, and the rule generally given is that *if the residuum is less than 75 c.c., no catheter is required; if between 75 c.c and 125 c.c. (2 to 4 ounces), the bladder must be emptied by catheter once a day; if between 125 c.c. and 200 c.c. (4 to 6 ounces), the catheter is required morning and evening; and for larger quantities three or more catheterizations a day are required, according to the severity of the symptoms.*

Such a rule may well be applied to the first few days or weeks of treatment; but, inasmuch as the passage of the catheter must soon be intrusted to the patient himself, he will inevitably form his own rules in accordance with the subjective symptoms rather than with a thought to the precise amount of retained urine. Moreover, patients in incomplete retention are frequently in no fixed condition. The bladder that retains 250 c.c. to-day may retain only 100 c.c. to-morrow. Indeed, the first effect of regular catheterization is often to reduce the amount of residual urine, and by systematic treatment the patient may sometimes be brought back from the second to the first stage of the disease.

Exceptionally, one is surprised to find that the passage of the cystoscope or searcher, which is calculated rather to irritate than to soothe the surface of the prostate, and usually increases rather than reduces the amount of retained urine, may, nevertheless, free the patient from

a considerable residuum. Yet, needless to say, rigid instruments cannot be employed as a routine measure for the treatment of prostatic retention.

Although it is often possible, by the methodical use of the catheter, to reduce the residuum, this end is not to be obtained by frequent catheterization. On the contrary, the less frequently the catheter is passed, within reason, the better results. The use of the catheter should be cleanly, gentle, infrequent, and systematic. The first three points require no further insistence; the last is quite as cardinal as any of the others. To use the catheter systematically is to use it intelligently.

Irregular catheterization is valueless. When the instrument is required but once in the twenty-four hours, it must be used immediately before retiring. When it is required twice, before retiring and on rising. When it is required three or more times—this part of the rule is the least observed—it must be introduced at regular intervals. As the dyspeptic stomach must be fed regularly, so must the overburdened bladder be emptied regularly. The intervals should be made mathematically even, if possible. Six in the morning, two in the afternoon, and ten at night are favorite hours, or, if the patient retires late, seven, three, and eleven. The evening catheterization must be at bedtime. The morning one seems early, but the patient's bladder will awaken him betimes.

Thus far *catheter life* has been considered as though entirely conducted by the surgeon. This is far from being the case. The surgeon must initiate catheter life. He must perform the catheterizations for the first few days; but, at the same time, he must instruct the patient, both by precept and example, how to perform the operation himself in a cleanly, gentle, systematic manner. The gentleness and system are the same for patient as for surgeon. The details of cleanliness differ somewhat. The patient should be instructed as follows:

1. Hexamethylenamin (0.5 to 1 gram a day) must be taken throughout the institution of catheter life and thereafter.

2. The hands must be washed with soap and water before each catheterization. Most surgeons advise that the glans penis be washed also. This the patient will very rarely do; he will give it up, and, finding no harm results, he will perhaps give up washing his hands as well. I am therefore contented with the hand-washing.

3. The patient must be shown how to pass the catheter without touching that part of it which enters the deep urethra.

4. The catheter is to be flushed inside and out with running water after using. It is then boiled for ten minutes, dried with a clean towel, and placed in a metallic box or between the folds of a towel, where it remains until again needed. The metallic box must be kept scrupulously clean. If a woven catheter is used, and a boilable one cannot be

obtained, the catheter must be washed carefully with soap and water and then flushed with running water before and after each catheterization.[1]

5. The lubricant used must be aseptic and kept in collapsible tubes.

6. The bladder must be washed daily until the first infection has passed and the bladder has acquired a toleration for the instrument. Then the intervals between washes is made progressively greater up to once a week, which is the usual limit of safety.

7. Special attention must be paid to combating constipation.

The *technic of autoirrigation* must be described in detail to the patient, and he must be made to perform the operation in the surgeon's presence. I shall describe only the method which I have employed. I have used various solutions, but now usually employ, in clean cases, a boric-acid solution, for the reason that this is easily made, and it is impossible for the patient to make the solution strong enough to irritate.

In some instances silver nitrate (1:10,000) must be used instead of boric acid.

The patient is supplied with a pint measure, a glass rod, a pound tin of granular boric acid,[2] a fountain syringe, a two-way stop-cock, a tube of sterile lubricant, and a number of catheters. He then proceeds as follows: First washing his hands and obtaining some water so hot that he can only just keep his finger in it (*circa* 115° F.), he fills the pint measure with this, adds a heaping teaspoonful of the granular boric acid, and stirs with the glass rod until the crystals are dissolved. This solution he pours into the fountain syringe, to which the two-way stop-cock is attached, and hangs it just above his head. He then attaches the hard-rubber nozzle to the clean catheter, lubricates the latter, and introduces it gently into his bladder. He introduces the catheter only far enough to strike water—the natural tendency is to push it in too far, and then to pull it out and in until the right spot is reached—and drains the bladder dry. Then he opens the stop-cock, allows the water to escape from the bag until it runs warm, turns off cock, couples cock and nozzle, turns on the stream again, and allows the bladder to fill. As soon as he feels any intravesical tension he turns the cock off and the fluid escapes into the vessel. By turning the cock on and off the bladder may be filled and emptied several times; for the present purpose one filling suffices.

In spite of every precaution the bladder soon becomes infected.

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[1] This system is not strictly aseptic. But the use of trioxymethylen (formalin) tablets or sublimate solution in the catheter box does more harm by irritation than good by antisepsis.

[2] Pulverized boric acid dissolves very slowly. If silver nitrate is to be used it may be kept as a 10-per-cent solution in a dropper bottle, of which 8 to 10 drops is dissolved in 500 c.c. of water.

2. **Infected Cases.**—Infection introduces several new features in treatment. The same cleanly, gentle, and systematic catheterization is required, but beyond this the infection itself must be treated as a posterior urethritis or a cystitis. If recent it should be attacked vigorously with the hope of conquering it. The stronger remedies, nitrate of silver or permanganate of potash, should be injected daily, and the surgeon should apply them himself.

If the infection is acute, rest in bed and anodynes may be required. Urethral fever may occur and require appropriate treatment. In these acute cases the danger of administering opium freely, whether by mouth or by rectum, should not be forgotten; the patient's future must not be unduly imperiled to assure his present comfort.

Chronic inflammation assumes one of two forms: (*a*) The urine is bacterial, acid, or neutral in reaction, and contains little pus; (*b*) the urine is ammoniacal and loaded with stringy muco-pus. Either form, if long continued, leads to pyelitis. For each the best general remedy is usually hexamethylenamin, or, if this is not tolerated, salol, or boric or benzoic acid. The mild form of inflammation is, in a sense, a boon to its possessor. It toughens his organs, as it were, and lessens the danger of serious inflammatory complications. Though not readily overcome, it is very easily controlled, and, if the patient is faithful to his urinary toilet with urinary antiseptics, catheter, and bladder irrigation, he may indulge in the little irregularities of aseptic technic, which all patients allow themselves in the long run, without any harm coming to him. Ammoniacal cystitis, on the other hand, is always a menace. Phosphatic stone, abscess of prostate, bladder, or kidney, and urinary fever, either acute or chronic, result from it, and energetic local treatment are required to control it. The retained catheter is often employed for this purpose with advantage when the prostate is not irritable. Stone should be suspected and searched for, and, if the ammoniacal cystitis, whether due to stone or not, cannot be controlled, operation is required.

3. **Irritable Cases.**—Irritable cases are very rebellious to treatment. An irritable case is one whose symptoms are made worse by all local measures, whether simple catheterization or irrigation. If the residuum is small, internal remedies, whether antiseptics, balsamics, or alkalies, may conquer the irritability; the rectal douche may be of assistance. But if these means fail, if the case does badly without local treatment and equally badly with it, there is no alternative but the knife.

4. **Obstructive Cases.**—Obstruction to catheterization is often an important feature. It may be impossible to introduce soft-rubber or even woven instruments into the bladder on account of spasm of the cut-off muscle or of some crookedness in the deep urethra. Spasm of the cut-off is oftenest caused by a soft linear stricture at the bulbo-membranous

junction, and the passage of a few sounds solves the difficulty; and even if there is no stricture, the gentle passage of a sound is often the best treatment to relieve spasm or to iron out a tortuous prostatic canal.

The retained catheter is especially useful here. By fastening a rubber or woven catheter into the urethra for a few days, the rough canal can be smoothed down. By this means the urine is also drawn off continuously, and the lessened congestion thus obtained often results in a notable diminution in the size of the prostate and the amount of residual urine.

Third Stage.—When there is complete retention with overflow the treatment is much the same as when the retention is incomplete. The first catheterizations must be conducted according to the rules laid down for acute retention. The catheter should be passed not more than three or four times in the twenty-four hours, if possible, even though a pint is drained off each time, for the distended and atonied bladder endures this retention better than the more frequent passage of a catheter. If the complete retention is of short standing it may, perhaps, be relieved by the retained catheter. If there is much irritability or inflammation, the patient may have to pass the catheter six, eight, ten, or more times a day to alleviate his sufferings. Such a condition is unbearable and demands operation if not speedily relieved by palliative measures, notably the retained catheter.

Overflow.—Overflow is the most disagreeable symptom of complete retention. If systematic catheter life can be instituted, the overflow is usually controlled; but if the bladder is contracted or irritable, the overflow may continue, to the great annoyance of the patient. If this symptom is not relieved by the catheter, irrigations, the retained catheter, etc., and the patient will not submit to operation, he must wear a urinal.

This urinal is useful only by day. During the night, when the patient's symptoms are at their worst, he must be satisfied to relieve himself as much as possible with the catheter and—wet the bed. A large rubber penis bag may afford some relief at night, if the patient can accustom himself to lie on one side and not to roll over in his sleep.

TREATMENT OF COMPLICATIONS

The treatment of *prostatitis, cystitis, irritability, obstruction to the catheter,* and *retention* have already been dealt with. True *incontinence* must be treated by the urinal. It may sometimes be relieved by stimulating instillations (nitrate of silver, 1:1,000) into the posterior urethra.

Stricture.—Soft stricture in the bulb sometimes results from hypertrophy of the prostate and causes annoying spasm of the cut-off

muscle. It is easily cured by the passage of a few sounds. Organic stricture requires dilatation in order that the prostate may be properly dealt with and this extra cause of retention removed. If there is much retention, and the kidneys are damaged, there is notable danger of chill and septicemia, to avoid which every precaution must be taken. If dilatation is impracticable, external urethrotomy and prostatectomy should be performed.

Stone.—It is often impossible to identify a small stone behind a large prostate. The X-rays and the cystoscope may be employed, but by neither means can stone be excluded with certainty if the bladder is sacculated or the *bas fond* deep. If a stone complicates a hypertrophied prostate, it is usually futile to attempt litholapaxy. Perineal prostatectomy and litholapaxy or suprapubic section should be performed. In the long run the patient will submit to operation as a happy relief to his symptoms.

False Passage.—The clinical history of false passage is characteristic enough. A prostatic obstruction is encountered by the surgeon. He cannot surmount it; he uses force; something gives way, the instrument (always a metallic one) is twisted out of its course, and the patient cries out with pain. It may be forced into the bladder and the urine withdrawn, or the bladder may not be reached. In either event the withdrawal of the instrument is followed by free hemorrhage, and its reintroduction is usually more difficult and painful than ever.

With such a condition of affairs it is usually best to drain the bladder by operation with immediate or subsequent prostatectomy. If the patient will not submit to operation, the bladder should be emptied several times by suprapubic aspiration before attempting any urethral instrumentation. In the meanwhile hot sitz baths, enemas, etc., should be employed to relieve prostatic congestion. After twenty-four or forty-eight hours of such treatment a double-elbowed catheter or Guyon's elbowed catheter is introduced with the greatest gentleness. These instruments, following the roof, will often escape the mouth of the false passage on the floor. Where they fail, the prostatic silver catheter may succeed. Special instruments, of which one part enters the passage while another avoids it, should never be used, since they keep the false passage open, whereas the surgeon's chief endeavor should be to encourage it to close.

If an instrument can be introduced into the bladder, it had better be tied in for two or three days. The false passage will thus be encouraged to close, and subsequent catheterizations will be comparatively easy. If, on the other hand, catheterism is impossible, or if an abscess forms in the prostate, the knife must be resorted to.

Epididymitis.—This is one of the most annoying complications of this disease. The epididymis may be stirred up by every passage of

the catheter, and yet the passage of the catheter may be imperative. The treatment for epididymitis is palliative up to the point of abscess formation, as indicated by considerable swelling (not due to hydrocele) or septic fever. These symptoms call for epididymotomy, and this may usually be advantageously preceded by ligation of the opposite vas, to prevent further epididymitis.

Renal Complications.—*Renal retention* (p. 336), *pyelonephritis* (p. 365), and *urinary septicemia* (p. 372) require the treatment appropriate to them. There is no need to repeat the special features here, although these often take a prominent place in the treatment of prostatic hypertrophy.

Hemorrhage.—If slight, the hemorrhage may be controlled by senecio aureus (4 c.c. *t. i. d.*) or by a single gentle passage of a Béniqué sound. If the bladder fills with clots, these may be aspirated out with a large piston syringe and a large woven catheter. After aspiration the bladder should be irrigated with Squibb's compound surgical powder, a heaping teaspoonful to 500 c.c. of water at 120° F. When this maneuver fails, suprapubic section should be performed at once, the clots emptied out, and further clotting prevented by continuous irrigation.

OBJECTIONS TO PALLIATIVE TREATMENT

Watson and Cunningham [1] formulate the objections to catheter treatment as follows:

(1) It is never curative. (2) Even though it may have been tolerated by the patient for a greater or less length of time, that fact is never a guarantee that it may not at any future time fail to give relief, or to save the patient's life, or spare him suffering. (3) In a considerable proportion of cases—probably not less than 10 per cent—this implement results in the death of the patient; no one can foretell in which of them this result will, and in which it will not occur. (4) It is always accompanied by the risk of having the patient attacked by one or another of the complications due to its use, or incident to hypertrophy of the gland, viz., prostatic abscess or inflammation of the gland, epididymitis, orchitis, abscess of the testicle. (5) It is the cause of many deaths because of its being put into practice by ignorant or unskilled medical men, few of whom hesitate to undertake it, and but few of whom are competent to do so. (6) In the cases in which it proves not to be palliative, the surgeon has been deprived of giving the patient the excellent chance of cure and good health which he might have promised had he been permitted to institute the operative treatment at first. In the face of this arraignment, it is not surprising that many expert surgeons have taken the stand that it is better to do away with catheter treat-

[1] "Genito-Urinary Diseases," 1908, I, p. 335.

ment altogether, and to concentrate the attention on the operative method, and improving it.

This arraignment of the palliative treatment of prostatic hypertrophy is fully justified. Each practitioner must draw from it his own conclusions, and decide which case is suitable for catheterism and which requires operation.

CHAPTER XXVIII

THE OPERATIVE TREATMENT OF PROSTATIC HYPERTROPHY—THE CHOICE OF TREATMENT

Twenty years ago no one operated upon the hypertrophied prostate. To-day every surgeon approaches this organ with a knife in his mind if not in his hand. The mass of literature upon the subject is appalling. Everyone operates; everyone writes; everyone defends his own views in his own way, and the result is that the variety of operations almost equals the number of operators. Some would operate always; a few would operate never. On one point only do they all agree implicitly, if not explicitly—viz., the prostatic may not be operated upon with impunity. The mortality of prostatectomy varies from 5 per cent to 15 per cent at the hands of different surgeons. In face of this single accepted fact I have not until now felt justified in urging early operation for this malady. We have been seeking many false gods. We have been diverted first to this side, then to that, in the hope of finding the safe and sure cure; from this diversity of effort has arisen a more correct understanding of what a hypertrophied prostate is and what must be done to cure it, and at last we are approaching the surgical ideal: an operation that removes the obstruction and does not kill the patient.

THE INDICATION FOR OPERATION

There is but one condition calling for operation, and that is *the failure of palliative treatment.* If the patient is failing in spite of the most minute care, if he cannot be got out of a precarious condition, or even if it is foreseen that palliative measures are about to fail—in any such case an operation should be strongly urged upon him. The presence of stone, unconquerable irritability of the bladder, persistent ammoniacal cystitis, progressive urinary toxemia or septicemia, increasing renal dilatation or suppuration—all these are indications for operation. On the other hand, an old man with a patient bladder and an acid cystitis, with some pyelo-nephritis, is no candidate for the knife. He endures the catheter well, and, even though he depend entirely upon the instrument, he only has to use it four or five times in the twenty-four

hours. He has no notable pain. His bladder gives him no more trouble than the rest of his organs. He can live out the full term of his life—ten, twenty years—in this condition. It is not fair, indeed it is not often possible, to persuade such a man to submit to considerable discomfort, with a very appreciable risk to his life, for the single purpose of ridding him of the catheter, to which he has become thoroughly accustomed.

But there are many cases in which the operative indications cannot be thus summarily decided. As for the patient, he may not acquiesce unless his symptoms force him to it. The agony of an acute retention or of a ceaseless strangury will quickly bring him to terms; yet either of these may often be entirely relieved by palliative means; while the slow progression of the disease, the persistent ammoniuria, the decreasing renal output, the failing appetite, the thinning, weakening limbs, the quickening pulse, the chalky white face, the hectic fever—these signs, so patent to the surgeon, make no impression upon the patient. He accepts them as the discomforts of old age, and will not hear of operation until too late.

As for the surgeon, let him beware of too earnestly advocating operation. Any operation upon an old man has some mortality which cannot be overcome, and though the most desperate case may rally splendidly, no health, strength, or vigor is proof against an embolus or an apoplexy, nor are any old man's kidneys, however apparently sound, to be entirely trusted. One of the healthiest men I ever performed prostatectomy upon died on the fourth day by cardiac embolism. Therefore I urge that the surgeon expend every effort, every artifice at his command, before he says finally to his patient, "You are failing, you are losing ground, you are wasting time. You have now every chance of being saved by operation; the longer you delay the less your chances." Then the responsibility of choice is off the surgeon's shoulders. If the patient refuses operation, so be it. If he accepts, he does so knowing that he has come to his last stand, and his elation at the victory which, in all human probability, awaits him will only be heightened by the appreciation of the dangers he has avoided.

Yet complete prostatic retention in an ignorant or careless old man (and how few old men are not either insuperably ignorant or utterly careless!) calls for operation. Thus practically all clinic cases require operation as soon as the prostatic retention is definitely established.

At the other end of the line, when kidneys, heart, head, and stomach all are failing, operation is still indicated. The mortality here is high, but the cures are little short of the miraculous.

PALLIATIVE OPERATIONS

- Aspiration of the bladder
  - suprapubic,
  - perineal (obsolete),
  - rectal (obsolete).
- Cystostomy
  - suprapubic
    - puncture,
    - incision,
  - perineal incision,
  - prostatic puncture (obsolete).

Aspiration.—Rectal and perineal aspiration are never to be employed. Suprapubic aspiration is of the most ephemeral value. By it we gain time—that is all. For acute retention it may be appropriate treatment; for anything else it is futile.

Cystostomy.—Cystostomy is the formation of a fistula in the bladder wall. A simple cystostomy does not interfere with the prostatic obstruction, but carries the stream of urine around it, and, although in some few cases the prostate, thus relieved of irritation, may shrink sufficiently to reëstablish the urethral right of way, this outcome is not to be expected, and cystostomy is performed either with the intention of establishing permanent drainage or as a preliminary to prostatectomy.

For permanent drainage, the suprapubic route is always chosen. The operation may well relieve pain and spasm, though sometimes it fails even to do this, but it does not necessarily cure cystitis, and it leaves the patient more or less incontinent, bound to an ungainly and stinking apparatus, chafed and wet in spite of infinite washings and powderings, and by no means a well man. Hence the field for this operation is daily becoming restricted by the extension of radical operations to more and more desperate cases, and when cystostomy is performed in these days it is often only for the purpose of alleviating the patient's symptoms until he shall have gained sufficient strength to withstand a more radical procedure.

This temporary cystostomy, since its adoption as a routine procedure by Chetwood [1] and others as the preliminary operation for desperate cases, has become widely recognized as a valuable means of draining the bladder and relieving sepsis and renal retention. By its use the patient, who would not survive a primary prostatectomy, is got into a condition in which he readily withstands the shock of the major procedure. Cystostomy is, of course, only a substitute for the retained catheter. Yet it is far more generally applicable than the catheter, which prostatics often bear very ill.

The cystostomy is done by the suprapubic or the perineal route, in

[1] Trans. Am. Ass'n of Genito-Urinary Surgeons, 1907, I, 82.

accordance with the prostatectomy that is to follow. In case of doubt, the perineal operation should be chosen, since it can be performed more rapidly.

RADICAL OPERATIONS

Castration (obsolescent).
Vasotomy (obsolescent).
Bottini's operation (obsolescent).
Chetwood's operation.
Perineal prostatectomy by intra-urethral enucleation.
Perineal prostatectomy by extra-urethral enucleation.
Suprapubic prostatectomy.

The Obsolescent Operations.—Castration, vasotomy, and Bottini's operation have been, to all intents and purposes, discarded in favor of other operations. Although the two former have manifest influence in the reduction of the congestion of the prostate gland,[1] it is questionable whether they ever cause the hypertrophied prostate to atrophy, and it is certain that whatever atrophy they do cause does not necessarily relieve the obstruction to urination, and has no effect upon the debilitated bladder. Published statistics would show that the functional results of castration and vasotomy are excellent; but they are no longer advocated on account, no doubt, of the great unrecorded list of failures.

Bottini's operation fails to fulfill the surgical indications because it is an attack upon the prostate undertaken through the urethra without digital examination of the precise nature of the obstruction, and without the possibility of verifying the fact that the obstruction has been relieved after the operation is completed. The surgeon does not know precisely what he is trying to do, nor precisely what he has done. Therefore, although Bottini's operation has relieved many cases of prostatic retention, it has failed to relieve many others, and it has caused the death of many patients through the uncertainty of the procedure.

These deaths are due to infection in the incised prostate, or to carrying the incision beyond the walls of the bladder or urethra and permitting infiltration of urine. Although the mortality of Bottini's operation is low (2 per cent to 6 per cent), the cases that die are often those that could readily be saved by some other form of operation.

Mortality of Other Operations.—The estimated mortality of perineal prostatectomy averages about 6 per cent (Proust[2] and Watson). Individual operators have reported a far lower mortality. Thus, Fergusson has reported 103 cases with 3.6 per cent mortality, and

[1] Cf. Keyes, Jr., *Med. Record*, 1900, July 21, p. 81.
[2] *Comptes Rendus de l'Assoc. Franc d'Urol.*, 1904, p. 184.

Young has performed 128 consecutive operations without a death, having previously reported 4.6 per cent mortality. Suprapubic prostatectomy has a rather higher average mortality. Thus, Freyer operated upon 350 cases with 7.3 per cent mortality. On the other hand, the Mayo brothers, in their last annual hospital report, show over 100 cases of prostatectomy within the year, almost equally divided between suprapubic and perineal, and with an approximate mortality of 10 per cent for each.

Chetwood's operation cannot fairly be compared with prostatectomy. It is applicable only to a limited number of cases, but when properly performed upon these gives a lower mortality than any form of prostatectomy. Thus, I have operated upon 30 cases with one death by this method. Inasmuch as the technic of prostatectomy has only been perfected within the past few years, the masters of each particular operation are able to report a progressively smaller list of mortality, both because of the improvement of their technic and because they are able to recognize those cases which are in such bad condition as to justify no radical operation. No man attempts to remove the prostate of every prostatic. The bolder surgeon, like Freyer, will always have a mortality running from 5 per cent to 10 per cent. The more conservative operator may well succeed in saving all his patients, but only at the expense of permitting some to die of their disease, or to pass their remaining days with a suprapubic fistula, who might, in the hands of the bolder surgeon, have been rid of their troubles.

Functional Results of Operation.—Suprapubic prostatectomy gives the best functional results. If the patient recovers from the operation, and if the operation has been properly performed, he may be expected to become entirely well. He runs no risk of incontinence of urine or rectal fistula, is likely to empty the bladder completely, and careful after-treatment should minimize the one risk of the operation, viz., prolonged healing of the suprapubic wound. On the other hand, the suprapubic operation gives a much more tedious convalescence than perineal prostatectomy, and usually confines the patient longer in bed.

Perineal prostatectomy, if entirely successful, is the most brilliant of all the operations upon the prostate. It permits the patient to be out of bed within a few days, and cures him entirely within two or three weeks; but it is a more difficult operation to perform properly than is suprapubic prostatectomy. It gives a small percentage of urethro-rectal fistulæ, even when performed by the best operators, and it leaves a small and indeterminate number of patients with incontinence of urine, partial or complete, after the operation.

Chetwood's operation is applicable only to certain cases. If successful, it subjects the patient to the minimum of inconvenience and cures him with the greatest rapidity. Several of my patients have

urinated through the perineal wound for not more than forty-eight hours and have healed as rapidly as patients upon whom simple external urethrotomy had been performed. Its dangers are those of perineal prostatectomy.

Choice of Operation.— If preliminary cystoscopy has not been, or may not be, performed, the suprapubic operation is the operation of choice, for it alone permits a thorough study of the precise nature of the intravesical growth and a full appreciation of the presence or absence of stone. Generally speaking, the surgeon unfamiliar with the technic of these various operations will succeed better by the suprapubic than by the perineal route. Perineal prostatectomy requires special skill and should be performed only upon patients who have been previously cystoscoped.[1] The Chetwood operation is limited in its field to the destruction of prostatic bars and strictures at the neck of the bladder. For this purpose it is ideal, and the proportion of cases that may be submitted to it is extremely large; but it requires fully as much technical experience as does perineal prostatectomy, and on account of the relative restriction of its field will never be as generally employed as that operation.

THE OBJECT OF OPERATING UPON THE HYPERTROPHIED PROSTATE

Almost every surgeon operates upon the hypertrophied prostate solely with the idea of removing the enlarged portions of that gland, and if he is bound to some special type of operation he endeavors to wrench the pathological conditions into agreement with his preconceived surgical notions. Now, the object of operating upon the hypertrophied prostate is distinctly not to remove the enlarged portions of the gland, but only to reëstablish the normal urinary outflow by removing the obstruction to this outflow. As was suggested in Chapter XXV, this obstruction is almost invariably an elevation of the bladder neck, and the obstruction usually takes one of the following forms:

(1) General hypertrophy, causing an obstruction due chiefly to the thickness of the pars intermedia, partly to an elevation of the neck of the bladder between the enlarged lateral lobes; (2) enlargement of the pars intermedia alone, either in the form of a bar or in the form of a pedunculated middle lobe which acts as a ball valve; (3) hypertrophy of one or both lateral lobes alone, causing obstruction by lifting up the neck of the bladder between the two enlarged lobes; (4 obstruction by unusual forms of prostatic hypertrophy, such as pedunculated lobes from the lateral aspects of the urethral orifice, or from the so-called anterior lobe.

[1] The expert may properly find exceptions to this rule.

In enumerating these obstructions we omit the alleged obstruction by compression of the urethra between two hypertrophied lateral lobes. That such lateral pressure exceptionally causes part of the obstruction is undeniable. As a general rule it is a negligible quantity. The urethra in these cases is an irregular-shaped, vertical slit through which urine can perfectly well flow, except for the obstruction at the neck of the bladder.

The removal of almost all of these obstructions may be accomplished by prostatectomy, without direct regard to removal of the obstruction. Thus, if the condition is one of lateral-lobe hypertrophy, removal of these lobes permits the bladder neck to drop down and the bladder to resume its function, while if the hypertrophy is general, or if the middle lobe alone is hypertrophied, removal of the diseased tissues removes obstruction.

But it is to be borne in mind, in operating, that the obstruction is almost invariably at the neck of the bladder, and no operation should be concluded without careful digital examination of the neck of the bladder to show that the obstructing ridge has been obliterated. Careful observation of this point will save the surgeon from the disgrace of gouging out small portions of the lateral lobes when the obstruction is really a prostatic bar. This point also illustrates why suprapubic prostatectomy, which is begun by incising the neck of the bladder in the median line, so frequently results in perfect cure, while perineal prostatectomy, which concerns itself chiefly with the lateral lobes, so frequently gives unsatisfactory results.

CHAPTER XXIX

STRICTURE OF THE NECK OF THE BLADDER

I know no common malady of the urinary organs more elusive than stricture of the neck of the bladder. I am confident that it may exist without causing any symptoms whatever. In young men it keeps up a severe posterior urethritis. In older men it simulates, and is commonly mistaken for, hypertrophy of the prostate. It is curious that this disorder, so much discussed by Mercier, Civiale, and the men of their time under the names *valvule du col, contracture du col,* should in our days be entirely overlooked, or classed as a variety of prostatic hypertrophy instead of receiving the clinical recognition to which it is entitled.

Stricture of the neck of the bladder is a rigid, fibrous, contracted condition of the vesical neck. The orifice is often so small and the contractured tissue so dense that the tip of the little finger cannot be forced through it, but the occlusion is never complete.

Varieties.—The line must be sharply drawn between tubercular and simple stricture of the neck of the bladder. The former possesses all the features of vesical tuberculosis, and is, clinically, quite distinct from simple contracture, although, pathologically, they resemble each other closely. At present we are concerned only with simple stricture.

Etiology.—Stricture of the neck of the bladder occurs in young and old alike, but it is not met with before puberty. The chief and almost the only cause of the disease (tuberculosis excepted) is chronic posterior urethritis. In some cases this is caused by stone in the bladder. in others by chronic urethritis on the surface of a hypertrophied prostate, but in most instances it is postgonorrheal. It is not infrequently a complication of stricture of the anterior urethra.

Pathology.—The stricture consists, like all strictures, of a scar surrounding the urethra and diminishing its normal distensibility. The site of this contracting sclerosis may be the whole prostatic urethra, but, as a rule, it is confined to the urethro-vesical orifice, the posterior urethra beyond being dilated.

This stricture acts precisely like prostatic hypertrophy in causing urinary retention and the other secondary phenomena of prostatism. Indeed, prostatic hypertrophy and stricture at the neck of the bladder may coexist.

Symptoms.—Stricture at the neck of the bladder has no one clinical type by which it may be constantly identified. While it doubtless may, in its milder forms, be quite symptomless, I have only been able to identify it clinically under one of three forms. In each case it is a stubborn and unmanageable condition.

1. *Posterior Urethritis.*—Stricture of the neck of the bladder commonly occurs as the result of a protracted chronic urethritis. The onset cannot be clearly defined, but, clinically, the diagnosis is suggested by a combination of certain symptoms—viz., a protracted posterior urethritis that does not respond to any local or general treatment, imperative urination, and some pain during and after urination, a pain which is the more notable since there is no acute inflammation to account for it. Imperative urination is a most distressing symptom. When the patient feels the call to urinate he must respond at once under penalty of losing a few drops of his urine, enough to saturate the tail of his shirt.

The *diagnosis* of such cases cannot be made with certainty unless there is evidence of obstruction to the urinary flow (dysuria) and, at least occasionally, residual urine. The history of such a case is simply that of a chronic urethritis that will not get well, plus imperative and painful urination.

2. *Stone in the Bladder.*—A strictured neck of the bladder is often met with in long-standing cases of vesical calculus.[1] Whether the stricture is due to the stone or the stone is secondary to the stricture, I do not know. Suffice it to say that the condition is similar to the third variety (see below), plus stone. The stricture may be quite unsuspected until, after the stone has been crushed, the case takes on the aspect of the first or the third variety of the disease, or in the course of a lithotomy a rigid vesical neck may be encountered. Occasionally the diagnosis is made during a litholapaxy by the obstruction to the admission of instruments. This obstruction is usually met with in the shape of a bar at the neck of the bladder (when, as a matter of fact, no prostatic hypertrophy exists) over which the instruments jump. Very rarely a large-sized litholapaxy tube may be caught in the grip of the contractured muscle. On forcing the instrument a trifle it is then felt to tear through the obstruction.

3. *Prostatism without Hypertrophy.*—The *prostatisme sans prostate* of the French means retention of urine without obvious prostatic hypertrophy. It is due to one of three causes, viz.: (1) median prostatic bar, (2) paralysis of the bladder, and (3) stricture at the neck of the bladder. The frequency of these conditions is in the order named.

Diagnosis.—When a chronic urethritis, whether gonorrheal or not, drags on indefinitely and is rebellious to treatment, stricture may be

[1] Exceptionally a contracture gives the symptoms to stone.

diagnosed if dysuria and imperative urination are present without any acute inflammation, and the presence of residual urine without hypertrophy of the prostate clinches the diagnosis.

In the second place, when there are all the symptoms and signs of prostatic hypertrophy, and yet the prostate is not hypertrophied sufficiently to account for the symptoms (and cystoscopy shows the absence of ball-valve middle lobe), there must be either stricture or bar. The diagnosis between these conditions can only be made on the operating table. The treatment for each is the same.

On the operating table this type of stricture is identified by digital examination of the posterior urethra (p. 887).

Treatment.—The indications for treatment are perfectly clean-cut. If the case affects the chronic urethritis type, it should be treated locally, until the patient's endurance gives out, in the hope that it may perhaps be cured thus. But if these means fail, or if the disease is of the prostatic type, it should be submitted to the knife. The only exception to this rule occurs in the stone cases. If these are submitted to litholapaxy, the bruising of the neck of the bladder by the large tubes, though this will cause a pretty active postoperative reaction lasting some weeks, may so tear the contracted bladder neck that a cure will result in the long run; yet such an uncertain and brutal treatment could not be advocated for other cases.

Operative Treatment.—Chetwood's galvano-prostotomy is the ideal operation both for prostatic bar and for stricture at the bladder neck.

Incision of the obstruction without cauterization excites dangerous intravesical bleeding in 25 per cent of cases.[1] Moreover, the cut incision does not heal "open," and the bladder neck must therefore be overcut if it is not burned, and the danger of incontinence of urine thereby incurred.

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[1] I have reported 60 operative cases in *Guyon's Annales*, 1905, August 15, p. 1201. At the time of this report I did not distinguish between stricture and bar.

CHAPTER XXX

ETIOLOGY OF INFLAMMATIONS OF THE UPPER URINARY TRACT

The upper urinary tract consists of the kidneys and their ureters, the bladder, and the posterior urethra. The cut-off muscle separates the upper from the lower tract. The former is inside the body, as it were, and is in its normal state entirely aseptic. The lower urinary tract—i. e., the anterior urethra—is in no way separated from the integument, and may contain the germs that flourish upon the surrounding parts.

Bacteria of the Healthy Anterior Urethra.—The flora of the anterior urethra have already been described in Chapter XIII.

BACTERIA OF URINARY DISEASE

Leaving aside prostatitis, the special characteristics of which have already been considered, the infections of the upper urinary tract are:

1. Infection of the urine with no appreciable lesion of the bladder or the kidneys—Bacteriuria.
2. Inflammation of the bladder—Cystitis.
3. Inflammation of the kidney, its pelvis, and the ureter—Pyelo-nephritis.

Inasmuch as the upper urinary tract is aseptic when in its normal condition, the three prime questions to be answered in regard to inflammations are:

1. What are the bacteria of urinary inflammations?
2. How do they obtain access to the urinary tract?
3. What are the accessory causes of inflammation?

Although the bacteriology of pyelo-nephritis has not been so thoroughly studied as that of cystitis and bacteriuria, the statistics of these latter two, collected by Albarran, Hallé, and Legrain,[1] probably express with fair accuracy the importance of the various microbes in all three varieties of urinary infection. These authors have collected 304 cases from the reports of Rovsing, Morelle, Denys, Reblaub, Krogius,

[1] *Guyon's Annales*, 1898, xvi, 1159.

Barlow, Melchior, and Bastianelli, and have classified the bacteria as *frequent* and *rare*. Their results may be tabulated as follows:

Frequent Bacteria

Bacillus coli—131 times (43 per cent)—89 times in pure culture.
Staphylococcus pyogenes—70 times (23 per cent).
Proteus of Hauser—26 times (8.5 per cent).
Streptococcus pyogenes—15 times (5 per cent).
Gonococcus—10 times (the authors think this figure unduly small).
Bacillus typhosus.

Rare Bacteria

Pneumococcus, diplo-bacillus of Friedländer, Bacillus longus ureæ (Rovsing), Diplococcus ureæ liquefaciens (Melchior), and many others found in isolated cases by individual authorities. These rare bacteria possess no clinical interest, and require no description here.

The bacillus tuberculosis, it will be observed, has been omitted from the above classification, and its consideration is reserved for a subsequent chapter.

Bacillus coli (*Urobacillus nonliquefaciens, Coccobacillus ureæ pyogenes*).—This bacterium, the most common of all, has been investigated by every writer upon this subject, but with widely differing conclusions. While most authors have placed it among the most active causes of cystitis, Rovsing [1] finds that it never causes cystitis, though sometimes a slight pyelitis.[2] These opposing views can only be reconciled by admitting the personal equation, and by frankly recognizing the fact that the virulence of this bacterium varies between wide limits. Numerous attested cases of cystitis [3] prove it not always so innocent as Rovsing believes, while the ever-increasing number of reported cases of bacteriuria containing the bacillus coli in pure culture show that its venom has been overestimated in the opposite camp. On only one point are all agreed—viz., that the bacillus coli is not ammoniogenic; it causes *acid* cystitis, pyelitis, or bacteriuria.

Clinically the bacillus coli may be put down as the usual cause (the gonococcus and the tubercle bacillus excepted) of all urinary infections in which the urine remains acid. It is, as a rule, but slightly virulent. Without a predisposing factor—a fertile soil upon which to grow—it causes no infection whatever. When it takes root upon a slight lesion

[1] *Guyon's Annales*, 1897, xv, 817, 1009, 1121, 1251, and 1898, xvi, 179, 278.

[2] Rovsing's position has been assailed by Melchior and by Albarran and Hallé (*Guyon's Annales*, 1898, xvi, 363, 388).

[3] These usually originate from a Bacillus coli prostatitis.

of the prostate or of the kidney (or its pelvis) it causes a bacteriuria or a mild pyelitis or prostatitis. When assisted by retention (prostate, stricture, stone, or tumor) it causes a more severe inflammation which may do permanent damage to the kidney, but is not likely to arouse any very acute symptoms or to produce any deep-seated lesions in the bladder. The bacillus coli may be associated with other bacteria in inflammations of the most intense severity.

Pyogenic Staphylococci and Streptococci.—These bacteria effect the decomposition of urea with the formation of ammonia. They are the common causes of *alkaline* cystitis and pyelo-nephritis.[1] Their virulence is greater than that of the bacillus coli. Like it they do not set up or maintain any urinary affection unless aided by an accessory lesion, but they very rarely cause bacteriuria, and the alkaline cystitis or pyelitis caused by them is usually severe in its symptoms and grave in its consequences.

Proteus of Hauser (*Proteus vulgaris, Urobacillus liquefaciens septicus*).—Experiments on animals at the hands of Krogius, Schnitzler, Bastianelli, and Melchior have shown that an intense and even a fatal cystitis may be produced, without the assistance of any predisposing cause, by injecting into the bladder a pure culture of the proteus vulgaris.

Like the pyogenic cocci this bacterium decomposes urea and causes *alkaline* cystitis. Probably it cannot take root and flourish in man without the aid of a predisposing agent, but it is nevertheless the most virulent of the common bacteria of urinary infection. Yet it has been found once in a simple bacteriuria.

Gonococcus.—It has long been known clinically that a gonorrheal inflammation may extend from the anterior to the posterior urethra and thence to the bladder, and that the gonorrheal prostate may form a base whence repeated incursions into the bladder are quite possible. Yet the proof of the existence of gonococcal cystitis has been singularly slow in appearing, and the cases reported are remarkably few.

The gonococcus alone, unaided by any predetermining cause, may excite an acute cystitis; in such cystitis the urine is acid and this purely gonorrheal cystitis recovers or is replaced by a secondary mixed infection so that the gonococci, if still present, can no longer be found. Hence that striking clinical condition, acute gonorrheal cystitis, may be accepted as purely gonococcal in origin; while nearly all the subsequent chronic manifestations in the bladder are due to secondary infection by those bacilli coli and pyogenic cocci that everywhere

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[1] Chute (*Boston Med. and Surgical Jour.*, 1908, clviii, 569) has collected and reported cases of alkaline bacteriuria and mild infections due to Staphylococcus pyogenes albus. No ammoniacal fermentation occurs in these cases.

follow in the wake of the gonococcus to perpetuate the inflammations inaugurated by it.

Gonococcic pyelo-nephritis is usually an intense process excited by urethral retention. It is very rare.[1]

Bacillus typhosus.—It is only within the last decade that the importance of the bacillus typhosus in urinary infection has been appreciated. According to the studies of Richardson [2] and Gwyn,[3] typhoid bacilli appear in the urine during the second and third weeks of the fever. Typhoid bacteriuria occurs in from 15 per cent to 30 per cent of all cases of typhoid. Grave pyelo-nephritis is rare, and while the bacilli usually spontaneously disappear from the urine they may remain for years. Typhoid bacilluria is peculiarly amenable to treatment. The urine is acid and closely resembles that of Bacillus coli bacteriuria.

Cystitis is extremely rare.

ROUTES OF INVASION

Bacteria may reach the interior of the urinary tract by one of four routes (Rovsing):

1. From the urethra—ascending invasion.
2. From the kidney—descending invasion.
3. By irruption of a neighboring focus.
4. By the circulation—indirect invasion.

Pathologists are still at odds as to the predominating importance of any one route over any other. For the first observers, Pasteur, Bouchard, and others, the urethra was all-important. Then Rovsng, Melchior, and Bastianelli, while still attributing the majority of cases to the urethra, recognized a renal origin for some cases. Albarran, Hallé, and Legrain hint that descending infection is more common than is generally believed. Infection through the blood or the lymphatic current has been made by most authors the special attribute of the tubercle bacillus, but Reymond [4] and Van Calcar [5] believe that the bacillus coli passes directly out of the rectum and in through the bladder when there is constipation or other intestinal obstruction. In the present state of our knowledge it is not possible to reconcile these opposing views, and in our consideration of the various routes of invasion it will be more practical to confine ourselves as strictly as possible to the clinical aspect

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[1] Ravogli has reported two cases and collected others in *Am. Jour. Urol.*, November, 1906.

[2] *Jour. of Exper. Med.*, 1898, iii, 349, and 1899, iv. *Jour. of Mass. Ass'n of Boards of Health*, 1899.

[3] *John Hopkins Hosp. Bull.*, 1899, x, 109.

[4] *Guyon's Annales*, 1893, xi, 253 and 343.

[5] *Ibid.*, 1899, xvii, 1253.

of affairs. It seems improbable, however, that normal epithelium, whether renal or intestinal, transmits living bacteria.

Urethral or Ascending Invasion.—The three methods by which microbes may ascend from the urethra are:

1. Through instrumentation.
2. By extension upward of a urethral inflammation.
3. By spontaneous ascension of the urethral bacteria.

1. The passage of an instrument into a clean bladder is a frequent cause of cystitis. The gentle passage of a smooth, soft, clean, instrument through a normal canal into a healthy bladder never causes cystitis. Perhaps bacteria are carried into the bladder by every instrument. Perhaps numerous pathogenic germs are often introduced in this manner. But experiment and experience unite to proclaim that the healthy bladder is thoroughly able to sweep itself clean of these enemies. Whether the germs come from a dirty catheter, or from an inflamed or a normal urethra, the bladder may be protected from them by the prophylactic injecton of nitrate of silver. But this is not enough. The bladder may be thus protected, but not so the posterior urethra. Not to mention the gonococcus, any of the specific bacteria enumerated above can take root in the prostatic portion of the canal if only the soil is sufficiently harrowed to receive the seed. Contusion or abrasion by the rough passage of an instrument often suffices, and if the bacteria are at hand, if a posterior urethritis is lighted up, if this posterior urethritis extends to the bladder and even to the kidneys, the heavy, rough, unskilled hand of the surgeon is to blame. No man with a general experience can fail to see that an infinite gentleness with a modicum of cleanliness spares the posterior urethra many woes into which it is plunged by the proud possessor of an infinite cleanliness with only a modicum of gentleness. It is not for me to depreciate cleanliness—the cleaner you are the better; but the gentler you are the best. A gentle catheterization followed by an antiseptic irrigation does not cause any inflammation, unless the prostate is already inflamed or considerably congested, unless the vesical powers of resistance are greatly lowered, or unless there are gonococci about.

2. Infection of the urine by direct extension of an anterior urethritis backward is met with clinically only in gonorrhea and stricture.

3. Whether the bacteria of the uninflamed anterior urethra can ascend to the bladder in face of the urinary stream is a question not yet definitely decided. Certainly they may ascend a short distance along the anterior urethra, for they have been found, in a certain proportion of cases, at varying depths in the canal. Paladino-Blandini [1] found

[1] *Guyon's Annales*, 1900, xviii, 1009.

that if pure cultures of the Staphylococcus aureus, the Bacillus typhosus, and the "bacillus of green pus" were placed within the meatus urinarius of the guinea pig, these bacteria could usually be found in the kidney at the end of twenty-four hours in the male, and at the end of forty-eight hours in the female. These experiments suggest that perhaps even immobile bacteria may travel against the urinary stream in small numbers, at least, and that the bladder and even the kidney may thus be invaded at any time. But before accepting such a theory, with all its startling possibilities, we must await confirmation of Paladino-Blandini's experiments by other observers.

With stricture of the urethra the combination of obstruction and infection is particularly favorable to the ascent of bacteria and the production of inflammation.

Renal or Descending Invasion.—Without stopping to debate the question whether or not the healthy kidney can transmit living bacteria in any numbers without injury to its secreting structure, we may accept as proved clinically, notably in the case of the typhoid bacillus, the fact that bacteria may enter the urine in great numbers from a kidney clinically sound. There is strong evidence for the belief that in the course of the various infectious diseases, even in tuberculosis, bacteria are commonly transmitted by the kidneys without leaving any appreciable trace of their passage through those organs. When the kidneys are inflamed their bacterial output is still less doubtful.

It has been shown, moreover, by Carle, Posner and Lewin, Lesage and Macaigne (*cf.* Melchior, Rovsing, Van Calcar, Albarran, Hallé, and Legrain), that any coprostasis or constipation enhances the virulence of the bacillus coli in the intestine and causes these germs to leave the intestine in great numbers. A certain number of these bacteria reach the urine, presumably by excretion from the kidney. It is the prevailing tendency nowadays to attribute the spontaneous infection of prostatics to this cause, and hence great stress is laid upon keeping their bowels clear to avoid this possible source of danger. Direct extension of a parietal inflammation from kidney to ureter and from ureter to bladder occurs only in tuberculosis.

Irruption of a Neighboring Focus.—The opening of an extraneous abscess into the urinary channels is rare. Perinephritic, perityphlitic, and, in the female, pelvic abscesses, may so rupture.

Invasion from the Circulation.—In spite of the contentions of Van Calcar and a few others, the great body of authors is united in denying that bacteria reach the urinary channels by emigrating from the general blood stream through the wall of ureter or bladder. It is generally admitted that only the tubercle bacillus may gain access to the prostate from the lymphatics.

ACCESSORY CAUSES OF INFLAMMATION

From a consideration of the facts briefly noted in the preceding paragraphs one is tempted to wonder not that the urinary organs become infected, but that they escape the infection that forever threatens them both from above and from below. If every infectious disease, every inflammation, every constipation sends its myriad of bacteria to the kidneys; if every colony of germs deposited within the meatus may send its scouts upward as far as the kidney, it requires some stretch of the imagination to call the upper urinary tract aseptic, and it encourages a belief in the bountiful dispensations of Providence to find that the bladder and kidneys are not perpetually inflamed. Yet there is another equally important side to the picture. We have seen the perpetual incursions of the enemy: let us look at the measures Nature has taken to repel them—or, to use a more striking metaphor—we have seen the perpetual sowing of the seed; let us now consider the soil, its natural fertility, and the means by which it is rendered more or less fertile, remembering that however rich the seed it cannot grow upon a barren spot.

In its normal condition the urinary tract is an unfavorable soil. The walls of the channels are smooth, protected by a thick layer of epithelium, and constantly irrigated by the urinary stream. It is probable that the renal epithelium possesses a bactericidal power, and it is quite possible that the vesical epithelium possesses the same power to a less extent (Van Calcar). Certainly the bladder shows a marvelous resistance to infection so long as its mechanical functions are not interfered with. Many and many a man lives for years with a kidney pouring down a continual stream of foul pus and bacteria into his bladder, and yet, so long as that organ can perform its functions properly, so long as there is no obstruction to urination, the bladder suffers even less from the putrid stream flowing through it than would the integument under similar circumstances. But let an obstruction to urination arise, let the bladder become overstrained and congested in its fight against a stricture, let a pool of residual urine collect behind a hypertrophied prostate, and inflammation at once results.

We have seen that most bacteria are not of themselves able to cause a urinary inflammation. Indeed, the gonococcus and the tubercle bacillus are quite unique in their capacity for causing an inflammation without any accessory lesions, and yet even they are not above availing themselves of accessory lesions when these exist. *No other bacterium can take root and multiply in the urinary tract unless the soil upon which it flourishes is congested.* Congestion is the plow that prepares the soil to receive the seed. This congestion may be acute or chronic. If acute it may be perpetuated by the bacteria once they have lodged. It ap-

pears under several clinical forms, of which the chief ones may be enumerated.

Bacteriuria is commonly perpetuated by a renal or a prostatic lesion.

Cystitis is usually kept up by retention (prostatic hypertrophy, stricture) or stone or tumor. It may be set up by trauma.

Pyelo-nephritis is usually kept up by retention, stone, or tumor. It may be set up by trauma.

The predisposing causes of bacteriuria are so special that they are best considered in the section devoted to that disease. The predisposing causes of cystitis and pyelo-nephritis are retention, stone, and tumor. That stone and tumor should cause congestion, ulceration, and in various ways undermine the resistance of the epithelium is no strange matter. But these conditions are special and none too common, while retention of urine is such an all-pervading cause of inflammation that it must be broadly though briefly considered here.

Retention.—The cause of retention of urine is commonly a urethral obstruction, and the urethral obstruction is commonly due to organic stricture or to hypertrophy of the prostate. It is true that "stricture and prostate" does not cover all the ground. Thus retention may be due to vesical paralysis without any obstruction whatever, or the obstruction may be ureteral and not urethral, or even if the obstruction be urethral, it may be due to other causes—to congenital tightness of prepuce or meatus, to stone, to spasm, to tumor; but, allowing all these exceptions, the overwhelming majority of retentions are due to urethral stricture or to prostatic hypertrophy. These are the cases that we meet in practice, with a well-defined set of congestive and inflammatory symptoms affecting the upper urinary organs throughout.

Effect upon the Bladder.—The first effect of any urethral obstruction is that the bladder is strained in the effort to empty itself. This strain implies congestion, and as the obstruction in the cases with which we are dealing is always chronic and usually progressive, so is the strain and with it the congestion, chronic and progressive. The bladder is pushed to the last extremity. In struggling to overcome the obstruction it undergoes compensatory hypertrophy; it gives all its reserve force to this end, and if other enemies appear in the shape of an invading horde of bacteria it is no longer in so fit a condition to expel them as it should be. Yet it usually escapes infection until its muscle has been sufficiently overcome to permit the accumulation of a pool of residual urine. This is the burden that cannot be borne. The bacteria now arriving find a safe harbor in the residual pool. Here they settle and multiply. They have leisure to work at the congested bladder wall, and if they are ammoniogenic the irritating changes they produce in the urine aggravate the inflammation to a marked degree. Clinically a chronic alkaline

cystitis is infinitely more severe than a chronic acid cystitis, unless that cystitis be tubercular.

From this brief review it will be observed that the *bacteria are not the most essential agents of infection.* They do no harm in the urinary tract until some adventitious cause comes to prepare the soil for their growth. Unless the predisposing cause is there no inflammation occurs. While the predisposing cause persists an inflammation may indeed be cured, but there is no assurance that it will not relapse. To cure the patient absolutely and permanently of his inflammation the predisposing cause must be removed. This done, the bladder will quickly dispose of the bacteria. This is the quintessence of urinary therapeutics: *to prevent inflammation avoid trauma; to cure inflammation relieve retention.*

Effect upon the Kidneys.—The effects of retention upon the kidneys may be summed up briefly. These organs become congested with the bladder, partly by a reflex nervous mechanism, but chiefly by the heightened urinary pressure transmitted from the bladder to the ureter, the pelvis, and the kidney itself. In these cases of "stricture and prostate" that we are studying the pressure increases slowly through a space of weeks or months. Hence there is commonly little or no distention of ureters or kidneys until absolute retention is reached. But all the while there is a chronic congestion, causing in the ureters an inflammatory sclerosis comparable on a small scale to that met with in the bladder, while in the kidney the sclerosis resulting from long-continued congestion takes the form of a chronic nephritis. The kidneys are thus permanently damaged. A certain proportion of the excreting epithelium is destroyed, and the remainder is forced to excessive work by this very loss. Thus the kidneys are as ready as the bladder to become bacterially inflamed. If now an inflammation flares up in the residuum of the *bas fond,* the kidney falls an easy prey to it. Yet even here evidence of a conservative effort on the part of the kidneys is not wanting. The kidney does not become dilated until the state of chronic complete retention has been reached, and it is a noteworthy, clinical fact that until the kidney becomes so dilated and pouched that it has its own *bas fond* it does not usually become infected by ammoniogenic bacteria. It may fall a prey to bacillus coli infection of a light catarrhal sort in its early days of infection, but it is not attacked by the bacteria of ammoniacal cystitis until it provides a special nook for their multiplication. Thus we frequently encounter cases of the most violent ammoniacal cystitis complicated by pyelo-nephritis, it is true, but acid pyelo-nephritis of a comparatively benign character. Or the reverse of the picture is seen: a pouched, suppurating, disintegrated kidney pouring its multitude of bacteria through the bladder, which latter is affected little or not at all, because it is fully able to empty itself.

Instrumentation.—Rough instrumentation may, by bruising the neck of the bladder, light up a prostatitis and perhaps some cystitis; but the cystitis is only caused indirectly and will be of short duration unless some other cause of inflammation steps in to perpetuate it. The cystitis caused by instrumentation in cases of stricture, hypertrophied prostate, or bladder paralysis is started by the instrument and perpetuated by the retention.

But there is one type of urinary infection caused by instrumentation and perpetuated by retention that is of peculiar interest. This is the infection of a bladder in acute post-operative retention. Here everything in the urinary organs is normal, but the patient cannot empty his bladder because of cut-off spasm. Such cases are readily infected by the catheter, and they remain infected so long as the retention persists. But get them out of bed, passing their own urine, and the cystitis abates spontaneously.

CHAPTER XXXI

THE TREATMENT OF URINARY INFECTIONS AND INFLAMMATIONS

So closely connected and so often confused are bacteriuria, cystitis, and pyelo-nephritis, and so many points of treatment do they possess in common, that it is convenient to group here their general therapeutic features, and to refer back to them in the succeeding chapters in such a way as to impress upon the surgeon the necessity of taking a broad view of the whole field. Thus, without losing sight of the particular details proper to each case and to each disease, he may appreciate what might be termed the Principles of Urinary Therapeusis applicable alike to the prevention and the cure of inflammation of the upper urinary tract. The subject may be subdivided into Prophylaxis, Palliative Treatment, and Radical Treatment.

PROPHYLAXIS

Clinically speaking, the prevention of urinary infection presents itself under three aspects:

1. The prevention of spontaneous infection when some disease of the urinary organs (notably prostatic retention) renders them especially liable to become inflamed.

2. The prevention of infection from urethral instruments.

3. The prevention of infection during or after operations upon the urinary organs.

1. The Prevention of Spontaneous Infection.—Since spontaneous infection of the urinary organs does not occur unless these organs are made vulnerable by the action of some predisposing cause, the ideal preventive is the removal of such a cause. Thus the removal of stone, stricture, or tumor safeguards the bladder and kidneys. But in many cases, notably in prostatic hypertrophy, such radical treatment may well seem more formidable than the disease itself. Then the patient must be forewarned of the constant danger of infection, and forearmed against it by instructing him in the rules of what we have elsewhere termed Prostatic Hygiene. He must model his every movement on the avoidance of congestion and excess by moderation in diet, exer-

cise, and exposure, by regulation of the bowels, by regular catheterization, if necessary, and with it urinary antisepsis. The details of this manner of life have already been considered (p. 308).

2. **The Prevention of Catheteral Infection.**—If there is one disease to which the term surgical is attached with opprobrium—viz., the surgical kidney—it is because of the gross carelessness shown by many surgeons in urethral instrumentation. Catheterism is such a vulgar operation and the bladder and kidneys resist infection so sturdily, that many a surgeon never learns to be gentle and soon forgets to be clean—for in the urethra cleanliness is next to gentleness—so that when he encounters a bladder or a kidney whose resistance is weakened, he omits the necessary precautions, and if a surgical kidney results from his catheterism it results indeed from his own act. The precautions with which urethral instrumentation should be surrounded—cleanliness before operation, gentleness during it, and antisepsis after it—have been detailed (p. 301). As we have suggested, these precautions may often be disregarded with impunity. If the urinary channels are entirely healthy, the *gentle* introduction of a catheter may do no harm, even though scant attention be paid to cleanliness. If the anterior urethra is inflamed, an indiscreet catheterism will result in prostatitis and epididymitis far oftener than in cystitis. A clumsy or rough maneuver will have the same result. But if there is predisposing disease, retention, paralysis, stone, or tumor, the minutest precautions often fail to prevent infection of the bladder and kidneys. In these cases every detail of gentleness, cleanliness, and antisepsis must be observed, not forgetting the so-called urinary antiseptics.

3. **The Prevention of Operative Infection.**—See p. 821.

PALLIATIVE TREATMENT

In the treatment of infection of the urinary tract some measures are employed purely for the purpose of alleviating symptoms. Many others, however, hold an intermediate position, as it were. They are sometimes palliative, sometimes curative. Thus the cure of a bacteriuria may often be accomplished by means that would only alleviate a chronic cystitis. Again, a cystitis behind a hypertrophied prostate may perhaps be effectually cured by urinary antiseptics, yet so long as the prostatic obstruction is not removed the imminent danger of relapse remains, and in course of time the inflammation will doubtless recur, so that the cure is often only a temporary one—a palliation, not an absolute cure.

Thus we class as palliative measures all forms of treatment that have for their object the reduction of inflammation, even though they may in certain cases effect complete and permanent abolition of the disease. These palliative measures may be classed as—

1. Anodynes, Balsamics, Alkalies.
2. Local Urinary Antiseptics.
3. General Urinary Antiseptics.
4. Diluents.

1. **Anodynes, Balsamics, Alkalies.**—**Anodynes.**—Whatever pain is associated with renal inflammations is not caused by any concentration or acidity of the urine. But the pain of cystitis is often considerably increased by a concentrated irritating urine, and the pains of urethritis even more so. But of all the drugs employed to relieve these pains anodynes are the least desirable. They exercise no beneficial influence except by giving rest and allaying spasm. In acute conditions it may be necessary to use them, but in chronic conditions they should be studiously avoided, and used if at all only with the constant purpose of dropping them at the earliest possible moment.

Balsamics.—Balsamics are more useful. They exhibit mild antiseptic and anodyne qualities in inflammations of the urethra and prostate, but they are of little use in inflammations of the urinary organs. Renal inflammations are not modified by them, and vesical inflammations are only influenced inasmuch as the prostate shares in the disease. Hence the cystitis of gonorrhea or of hypertrophy of the prostate is more influenced by balsamics, as a rule, than any other form of the disease. Their virtues have been discussed in Chapter XIX.

Alkalies.—Alkalies have a more direct bearing upon the urinary organs proper. They render service in the treatment of all forms of cystitis, (1) by overcoming hyperacidity of the urine; (2) by diluting the urine by virtue of their diuretic properties; (3) by a slight antiseptic influence. The advantage of reducing the urinary acidity is notable even in alkaline cystitis, for, unless there is ammoniacal pyelitis as well (which is unusual), the urine when it reaches the bladder may be sufficiently acid to irritate the inflamed mucous membrane with which it comes in contact. Neutralization of this acidity eliminates the irritation without increasing any tendency to ammoniacal inflammation which may exist. Indeed, the feeble antiseptic property of the alkalies helps to diminish the inflammation of any mucous membrane with which they come in contact. The diuretic property of the alkalies is further useful in preventing undue concentration of the urine and in assuring a free urinary outflow. The special properties of the alkalies most frequently used have been considered in Chapter XIX.

To sum up: Anodynes, balsamics, and alkalies are useful in the treatment of urethritis, prostatitis, and cystitis. Their purpose is to lessen the disagreeable symptoms of these diseases and to render the urine innocuous. The more chronic the inflammation the less serviceable are these remedies. They may sometimes effect a cure, but are usually relied upon merely as adjuvants to local treatment.

2. **Local Urinary Antiseptics.**—Topical applications to the urethra and bladder have long been employed in the treatment of inflammations of these organs. Recently lavage of the inflamed kidney pelvis has been advocated. Although enthusiastically supported by certain surgeons, it has not yet passed the experimental stage (p. 392). We shall therefore confine our remarks here to those antiseptics that have been found useful in the bladder.

Nitrate of Silver.—Of the older applications nitrate of silver is the best, and among the newer ones it stands in the first rank. It is employed by instillation or by irrigation. Whatever the method employed, the strength of the solution should be carefully graduated according to the sensitiveness of the patient. Some patients cannot endure nitrate of silver except after a prolonged course of preparatory treatment. The prevailing practice of disregarding the patient's sensitiveness and burning him cruelly with each injection cannot be too strongly condemned. Tubercular cystitis is made worse by nitrate of silver.

Irrigations are chiefly employed for the general cystitis of prostate, stone, or tumor. Instillations are generally more serviceable in posterior urethritis and in acute cystitis. When irrigations are employed the first strength should be between 1:20,000 and 1:10,000. If the patient bears this well, the treatment is repeated daily, or on alternate days, increasing the strength of the solution by about one third each time. This course is followed as long as the urine is rendered clearer and while the symptoms are diminishing. But any evidence of irritation, whether by an increase in the intensity of the symptoms or in the quantity of pus, is a signal that the dose is too strong or too frequently repeated. The next irrigation should be postponed a day and administered in less strength than the last; or it may seem wise to change to another remedy, or to administer an anodyne, and temporarily to desist from all local treatment. Although the tissues grow quite rapidly tolerant of stronger solutions, the action of these solutions cannot but be intense and the tissues require a longer time to react. Thus, solutions of 1:6,000 should not be employed oftener than every other day, nor solutions of 1:3,000 oftener than twice a week. Many patients cannot go higher than 1:4,000, while others take 1:1,000 without serious protest.

Instillations may begin between 1:2,000 and 1:1,200. They are employed every other day or twice a week. Two or three visits are usually required to accustom the urethra to the drug, which may then be run up rapidly to 1 per cent or even 5 per cent, when a maximum effect may be expected.

In acute gonorrheal cystitis no local application compares with an instillation of nitrate of silver. In other forms of acute cystitis I have not found it remarkably efficient. In chronic cystitis of any kind it is one of the best of local applications.

Protargol.—Of the newer synthetic silver salts protargol seems the most useful. I have employed argyrol, argonin, and argentamin, but with unsatisfactory results. Protargol is most useful in the urethra, but it may be used in the bladder when nitrate of silver is too irritating. The dose by instillation is from 1 per cent up to 20 per cent, beginning at the low figure; by irrigation from 1:1,000 to 5 per cent.

Potassium Permanganate.—This drug is to the urethra what the silver salts are to the bladder. In the latter organ potassium permanganate may be employed when nitrate of silver irritates. It is especially useful in acute cystitis when the silver instillation fails. It is employed only by irrigation. I have used it in strengths varying from 1:8,000 to 1:3,000.

Boric Acid.—Boric acid is very mildly aseptic; it has no very specific action upon the bladder, and yet it holds a place in bladder lavage from which it will not be easily dislodged. This is on account of its entire innocuousness. It may be placed in the hands of the patient with the assurance that it will do him a definite good and can do him no harm. As far as I know, it is the only wash that can be intrusted to the stupidest patient with entire safety. The reason of this is that even in saturated solution it is entirely unirritating. The saturated (4 per cent) solution is always employed. About 10 grams of the crystalline boric acid (pulverized boric acid dissolves less rapidly) is mixed with 200 c.c. of hot water. After stirring for a minute or so the residue is allowed to sink to the bottom and the solution is ready in sufficiently accurate strength for all practical purposes.

The ease with which the boric-acid solution is prepared makes it superior to salicylic-acid solution, Thiersch's solution, or physiological salt solution. I use it for all mechanical irrigating, for the purpose of cleansing the bladder and filling it for cystoscopy, stone-searching, etc. It is also most useful for the daily prophylactic irrigation of prostatics. It will not cure cystitis, but it helps to prevent it.

Corrosive sublimate is useful only in tubercular cystitis (p. 472). Carbolic acid is not suited to vesical irrigations.

3. **General Urinary Antiseptics.**—Thus far we have been concerned with remedies whose sphere of influence does not extend above the bladder. The last two classes with which we shall deal relate chiefly to renal inflammations, though their influence may be marked in inflammation of the bladder as well.

Under the term general urinary antiseptics I mean to include those remedies which, when administered by the mouth, produce such change in the urine as to render it a germicidal fluid. The number of drugs that exercise this influence in some slight degree is doubtless very great. Several of the alkalies and most of the balsamics already enumerated give the urine some antiseptic properties; but the urinary antisepsis of

these drugs is overshadowed by the stronger influence of certain remedies about to be described. The four chief ones are hexamethylenamin, salol, benzoic acid, and boric acid.

Hexamethylenamin.—The ammonium salt of formaldehyd is the most valuable drug we possess for combating pyelo-nephritis and many other urinary diseases. Unfortunately it is sold only under such trade names as urotropin, cystogen, and formin. The drug was introduced to the profession by Nicolaier,[1] and it is to him that we owe most of our knowledge of its chemical, physical, and physiological properties. Its most notable characteristics are:

1. Its action is almost confined to the urinary organs.

2. Its action upon the urinary organs is due in large part to its splitting up under the influence of the urinary acids, with the result that formaldehyd is liberated in the urine.

3. Its alleged effects are five: antiseptic, irritant, antiphosphatic, antiuric, and diuretic.

Antiseptic Effects.—Hexamethylenamin is the best urinary bactericide we possess. Yet it is not infallible. Sometimes it will even fail when other urinary antiseptics will succeed, and it will often fail unless used understandingly, its merits appreciated, its deficiencies recognized, and its limitations defined.

Hexamethylenamin is employed in bacteriuria, in pyelo-nephritis, in cystitis, and in posterior urethritis. In the treatment of *bacteriuria* this drug is invaluable. It prevents and controls almost all cases of typhoid bacilluria and pyelitic coli bacilluria. It may be necessary to employ it to the limit of toleration, even in doses of 3 to 6 grams a day, in order to control an existing catarrhal pyelo-nephritis; but once the bacilli have been driven from the urine they may be kept away by smaller doses, which, however, may have to be continued for many weeks in order to prevent recurrence. In vesical bacteriuria hexamethylenamin is a useful adjuvant to local treatment, but the local remedies must be depended upon to effect the cure. In suppurative *pyelo-nephritis* its germicidal virtues are again of the utmost value. Suppurative pyelo-nephritis is commonly encountered only after it has reached a chronic state, and hence little good may be expected to accrue from the high initial doses that prove so useful in overcoming catarrhal pyelo-nephritis. On the other hand, I recall at least four or five cases in which renal suppuration of long standing and some severity has been controlled by small doses, 0.5 to 2 grams a day, administered for several months.

The treatment of *cystitis* and *posterior urethritis* by hexamethylenamin does not at first sight seem entirely rational. The drug, though

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[1] *Centralbl. f. d. med. Wiss.*, 1894, xxxii, 897. *Zeitschr. f. klin. Med.*, 1899, xxxviii, 350.

antiseptic, is distinctly irritating, and is therefore less likely to be beneficial than balsamics and anodynes. In straightforward cases of chronic posterior urethritis, and in cases of acute cystitis it has been my experience that hexamethylenamin does more harm than good. My happiest experiences with the drug in this connection have been (*a*) in preventing the occurrence of cystitis in old men reduced to catheter life and in the prevention of catheteral and operative infection in general, (*b*) in preventing the occurrence of urethral chill or suppression of urine after the passage of sounds as well as after urethrotomies, cystotomies, and other operations on the urinary organs, and (*c*) in conquering that irritable form of posterior urethritis that flies to chills and swelled testicles every time any attempt is made at local treatment. The singular freedom from postoperative chill and suppression enjoyed by my patients since I began employing it as a prophylactic has led me to use it as a matter of routine. I administer two or three 0.5-gram tablets the day before the passage of a sound in stricture cases, and the same dose for two days before every operation upon the urinary organs. As hexamethylenamin is found in the urine for two or three days after its administration, it need not be resumed until the second day after operation. I have related elsewhere [1] several striking examples of its action in the conditions enumerated above.

Irritant Effects.—The dosage of hexamethylenamin is determined chiefly by its irritating properties, which vary with each individual, and with the same individual at different times. The irritation manifests itself under four forms: (1) Irritation of the bladder, (2) irritation of the kidneys, (3) digestive irritation, and (4) cauterization of wound surfaces. The *irritation of the neck of the bladder* is much the more important. This it is that marks the limits of tolerance to the drug. All observers are agreed that the more water drunk with hexamethylenamin —i. e., the greater the urinary dilution—the less likely it is to irritate. I have known 1.5 grams a day to cause an intense strangury within twenty-four hours. Yet I have had a patient take 4 and 5 grams of this drug a day for weeks together without any ill effects, and Nicolaier states that certain individuals can take 6 to 10 grams a day. The underlying cause of these peculiarities is not known, but they are a warning always to begin administering the drug in small quantities, not to increase the dose without at the same time increasing the amount of water imbibed, and to recognize that in some cases the limit of tolerance may be reached before the limit of efficiency is attained, in which case the drug must be given up. Yet such cases are quite exceptional.

Irritation of the kidneys, shown by albuminuria and even hematuria,

[1] *Phila. Med. Jour.*, 1900, vi, 606.

was noted experimentally by Nicolaier, and is rarely observed in the clinic. Yet this form of irritation is most unusual.

Digestive irritation, shown as gastric or intestinal irritation, is not uncommon. It may usually be avoided by dilution of the drug.

Happily there is another not less interesting side of the question. A certain mild irritant effect produced by the drug upon the kidneys and the neck of the bladder is probably the cause of its efficiency in certain cases. Thus a light renal stimulation may well be one element in the prevention of chill and acute suppression by this drug, and I have attributed the few cures of posterior urethritis that I have obtained by the use of hexamethylenamin to a similar stimulating effect upon the neck of the bladder.

An evidence of hexamethylenamin irritation that may not be overlooked is its effect upon the urine. If the urine is hazy with pus (e. g., in a case of pyelo-nephritis or bacteriuria) and hexamethylenamin is employed in sufficient quantity to clear the urine, the irritation may be sufficient to provoke an epithelial desquamation that clouds the fluid quite as much as before. To the casual eye there is no notable change in the urine. Yet the desired effect has been attained: the urine has been cleared of its pus, and is now clouded with the epithelial exudate due to mechanical irritation. If this fact is overlooked and the drug pushed vigorously, the irritation will increase and the inflammation apparently grows worse instead of better. The distinction, therefore, is a cardinal one, the neglect of which may lead the surgeon sadly astray. Of the several more or less accurate tests for establishing this distinction the test by centrifuge and microscope is easily the best. The supposedly bacterial or purulent urine is centrifuged for three minutes at about 250 revolutions a minute. If the haze is bacterial the fluid remains hazy, while whatever pus is present will be found collected at the bottom of the tube. But if the urine has been cleared of bacteria the centrifuge renders the urine completely clean and sparkling, while what was before a haze is now a sediment. This sediment, if examined under the microscope, is found largely epithelial if due to irritation, largely purulent if due to inflammation. Therefore, it must be remembered that the effect of treatment often cannot be discerned without the aid of the centrifuge and microscope, and it is a safe rule in practice to gauge the progress of the case chiefly on this showing.

A very rare mishap, which has occurred once in my practice, is the *cauterization of a wound* in the bladder by the urine containing hexamethylenamin.[1] A few similar cases have been reported. If the surgeon at any time encounter a case whose operative wound, instead of healing, becomes covered with a leathery slough and seems daily less

[1] Cf. *Phila. Med. Jour., loc. cit.*

likely to heal, and if this result is due to hexamethylenamin, he must recognize the fact and eliminate the cause immediately. Similar sloughing is seen in wounds treated with formaldehyd.

Antiphosphatic and Antiuric Effects.—Although not germane to the subject of urinary antisepsis, the antiphosphatic and antiuric effects of hexamethylenamin merit a word here. Curiously enough, this drug was at first praised as a uric-acid solvent rather than as a disinfectant. German authorities have insisted that hexamethylenaminized urine is an excellent uric-acid solvent at the body temperature. It will even dissolve uric-acid calculi *in vitro*. Caspar also insists upon its value in phosphaturia. According to this author, not only do the phosphates disappear from the urine while the drug is being administered, but the phosphaturic tendency is also permanently overcome if its administration of the drug is continued for a sufficient length of time. I have not been able to verify this claim.

Diuretic Effects.—Authorities do not agree on the subject of diuresis by hexamethylenamin. In most cases it is certainly not markedly diuretic, yet severe postoperative suppression is sometimes immediately relieved by it. In this connection a case in Dr. Chetwood's practice merits quotation:

Mr. A. B. submitted to an external urethrotomy for stricture. During the twenty-four hours following operation he passed but 2 or 3 ounces of urine. His temperature rose to 105° F., his pulse was tumultuous and irregular, and he was apparently about to die of acute suppression of urine. Hexamethylenamin was then administered (0.5 gm. *q. i. d.*) and within twenty-four hours the floodgates were opened, the temperature and pulse came down, and for two or three days all went well. Then, to test its efficacy, the drug was withdrawn. Within a day the urinary excretion became much less and temperature and pulse ran high again. Again the hexamethylenamin was administered, kidneys, temperature, and pulse promptly reacted, and the convalescence thereafter was uneventful.

No more striking example of diuresis could be desired. I have seen similar effects in other cases, but only when the kidneys were acutely congested. This diuresis is due to the mildly stimulating effect of the hexamethylenamin upon the kidneys. When these organs are normal or chronically congested (e. g., in chronic uremia) the diuresis produced by hexamethylenamin is insignificant. In acute congestion it is most notable.

Résumé.—The above description of the qualities of hexamethylenamin is not in accord with the teachings of many of the best authorities. It is founded, however, on a large clinical experience extending over several years, and if I do not accept hexamethylenamin as an approprite drug for the routine treatment of gonorrhea, chronic urethritis, and cys-

titis, it is because I have been unable to convince myself of its constant efficiency in these maladies. The following facts I can vouch for from my own experience:

1. In bacteriuria and in light pyelo-nephritis hexamethylenamin seems almost a specific.

2. To prove effective in these diseases it may have to be administered in high doses until the urine is practically clear of bacteria, after which smaller doses may suffice.

3. The progress of the cure can be judged only by constant recourse to the centrifuge and microscope.

4. The dose must not be sufficient to cause irritation.

5. The possibility of such irritation cannot be overlooked, even when very small doses are employed.

6. In diseases of the bladder and the prostate hexamethylenamin may often be depended upon to prevent inflammation, but is only of secondary importance in controlling it, and may even be positively harmful by its irritant properties.

7. In the treatment and prophylaxis of the various forms of urinary septicemia and urethral chill hexamethylenamin is often most useful.

8. Its routine employment both before and after operations on the urinary passages is indicated.

9. The urine containing hexamethylenamin occasionally has an escharotic effect upon wounds, which may constitute a contra-indication to its employment.

10. Hexamethylenamin is an admirable diuretic in postoperative suppression.

Helmitol.—This compound of hexamethylenamin seems as effective therapeutically, and is sometimes distinctly less irritating. Dose: same as hexamethylenamin.

Hetralin.[1]—Of the many other substitutes for hexamethylenamin the only important one is hetralin. This drug liberates formalin in alkaline urine much more freely than does hexamethylenamin. Its dose is the same.

Salol.—Salol is commonly placed second in the list of urinary antiseptics. This drug is disintegrated in the upper intestine into its component salicylic and carbolic acids. These antiseptics are absorbed into the system and excreted in the urine, where they exert their antiseptic action. But in order to obtain any very definite antiseptic effect on the urine as much as 3 or 4 grams a day must usually be administered. This is a large dose for any stomach to bear, and as the patients for whom the drug is likely to be most serviceable are often urinary dys-

[1] Cf. *Folia Urologica*, January, 1909, p. 507.

peptics, the stomach may rebel before the drug does any good. When well borne, however, the effects of salol are excellent. It has not the immediate bactericidal effect of hexamethylenamin, but may be employed as a prophylactic against cystitis or in the treatment of any inflammation of the urinary organs when hexamethylenamin fails. It does not irritate the bladder, but when given in overdose produces the smoky urine of carbolic-acid poisoning.

Benzoic Acid.—Benzoic acid and the benzoates of sodium and ammonium are employed, as a rule, under the vague impression that they acidify the urine, and thereby antagonize ammoniacal cystitis. Happily the practice is sounder than the theory. As Dr. William Ashhurst [1] has shown in experiments with the sodium salt, its effects are:

I. An inconstant diuretic action, accompanied by a slight diminution of the acidity of the urine.

II. A retardation or absolute prevention of alkaline fermentation.

III. An action in nature germicidal or inhibitory to the growth of certain microörganisms either within the bladder or when introduced into the urine after voiding, these susceptible organisms including especially those which tend to produce the alkaline fermentation, but which develop in the urine while it is still acid.

Thus the administration of sodium benzoate diminishes instead of increasing the acidity of normal urine, and maintains the urinary acidity only by opposing ammoniacal fermentation. Hence it is solely a urinary antiseptic. In strength it ranks a little below salol, but is rather more digestible than that salt. Dose: 3 to 6 grams a day.

Boric Acid.—Boric acid and borax (sodium biborate) are both employed as urinary antiseptics, but their strength is less than that of the above-mentioned drugs. Two or three grams a day may be administered.

Methylene-blue.—This drug is frequently employed as a urinary antiseptic, but its inconveniences far outweigh its virtues.

4. **Diluents.**—Diluents are all-important in the treatment of every inflammation of the urinary tract. They diminish the density of the urine, not by lessening the output of solids, but by increasing the watery excretion of the kidneys. Thus their primary action is upon the kidneys. These organs are stimulated to a free physiological action, and any tendency to congestion or inflammation in them is minimized or entirely overcome. The urine itself is rendered more bland, its crystalline contents more fully dissolved, its acidity or alkalinity lessened. The flow of urine is increased, less time is given for bacterial proliferation in the pelvis of the kidney, and the bladder is scoured by more frequent

[1] *Phila. Med. Jour.*, 1900, v, 457.

acts of micturition. Thus the sum of the action of diluents is: (1) Diminution of any kidney congestion that may exist, (2) diminution of the irritating properties of the urine, and (3) increased irrigation of the inflamed cavities.

Dilution of the urine—diuresis—may be obtained either by administering drugs that increase the excretion of water through the kidneys or by increasing the amount of water drunk by the patient. It is convenient for our present purpose to divide diuretics into three classes:

1. Medical diuretics: drugs that are admirably diuretic in various diseases of the kidneys, but for one reason or another are not useful in inflammations of the urinary tract, except for their effect upon the kidneys. Such are digitalis, calomel, sodio-salicylate of theobromin (diuretin), broom, squill, pilocarpin, gin, etc.

2. Diuretic drugs that are useful in certain urinary inflammations —viz., the alkalies, especially potassium acetate, hexamethylenamin, and the balsamics.

3. Water, the great diuretic.

Diluent Drugs.—All of the medical diuretics referred to above are of value for their effect upon the kidneys. They may be absolutely essential to the treatment of certain cases complicated by grave organic changes in the renal parenchyma; but for their simple diluent effect they are not employed, since the alkalies, the balsamics, urotropin, etc., have an equal diuretic effect combined with some medicinal effect upon the inflamed surfaces of the urinary tract. But, after all, water is the diluent upon which we depend most.

Diluent Waters.—There are waters and waters. Some are diluent and some not, entirely apart from their chemical ingredients. The general test which may be applied to any given water consists in drinking it freely and noting whether it lies heavy on the stomach. The water that can be drunk in greatest quantity without overloading the stomach is in practice the best diluent. Thus rain water is more diluent than well water, as a rule; still water more than charged water; alkaline more than acid water. Yet, quite apart from these broad properties, some waters are more diluent than others, quite as gin is more diluent than brandy, and beer more diuretic to some persons than to others, and for reasons equally obscure. For ordinary dilution of the urine, such as is a part of the treatment of every one of the inflammations in question, rain water or reaërated (not charged) distilled water suffices, if drunk freely up to 3 or 4 pints a day. For more marked dilution, such as is useful in the treatment of bacteriuria and pyelo-nephritis, Poland water, or any of the alkaline or lithia waters may be employed. In some cases, notably in acute or severe pyelo-nephritis, in obstinate bacteriuria, and in partial or total suppression of the urine, postoperative or other, the greatest possible diuresis is required. Apart from drugs, such as potas-

sium acetate, hexamethylenamin, etc., the best means I have found of overcoming these conditions is the use of Suwanee water. This water is more diluent than any other with which I am familiar. Like all mineral waters it is most efficient at its own spring, where as much as 5 gallons have been drunk in a day by one man.

VACCINE TREATMENT

Autogenous vaccines have been much employed of late, with little success. They are worth trying in septic cases or in mild intractable cases.

RADICAL TREATMENT

The radical treatment of any inflammation of the urinary organs is the removal of that predisposing retention, irritation, or congestion, which gives the bacteria their opportunity to attack the tissues. This implies special treatment for each special disorder. At the same time the palliative measures must be applied in order to help allay the inflammation. The cure of an inflammation by palliative measures alone, without recourse to radical treatment, is too often only temporizing with the main issue.

The most important feature of radical treatment is drainage. To provide adequate surgical drainage for the urinary organs is the object of many operations and of most catheterism.

CHAPTER XXXII

CYSTITIS

The inflammations of the bladder are reducible to a very small number of clinical types, though each of these types has many variations. Authorities differ so widely in their classifications of cystites that an accepted classification can hardly be said to exist. The following simple scheme will suffice for our purposes:

- Nonbacterial Cystitis
  - Traumatic.
  - Chemical.
- Bacterial Cystitis: Simple
  - Acute.
  - Chronic
    - Acid.
    - Alkaline.
  - Interstitial.
  - Pericystitis.
- Tubercular Cystitis (p. 466).

The nonbacterial cases will be dismissed briefly. Tubercular cystitis is considered in a subsequent chapter.

NONBACTERIAL CYSTITIS

Nonbacterial cystitis is the natural reaction of the vesical mucous membrane to a mechanical or a chemical irritant.

Traumatic Cystitis.—A mild cystitis or irritability of the bladder, as it is often called, may be caused by the passage of concentrated urine containing phosphates, urates, or oxalates. There is more or less urinary frequency and distress, and besides the crystals the urine contains a trace of pus. The so-called gouty or rheumatic cystitis is of this nature.

A more severe inflammation without infection is commonly caused by stone in the bladder and by rough instrumentation. In such cases there may be much tenesmus and distress together with an abundance of blood and pus in the urine, and yet no infection.

Treatment.—The irritation may be dispelled by diluting the urine and correcting the cause of the urinary concentration by diet, exercise (or rest), and the free use of water. Local treatment rarely has to be applied.

Chemical Cystitis.—Any strong irritant entering the healthy bladder, whether from above or below, causes cystitis. The intense strangury caused by the administration of cantharides has acquired an undeserved notoriety on account of the alleged sexual excitement accompanying it. As a matter of fact, the acute prostatic congestion induced by this drug is said to cause priapism, but the sensations of the patient in this condition are anything but pleasant. Rehn, and later Lichtenstein,[1] have called attention to a similar strangury occurring in coal-tar workers, apparently due to inhalation of irritating vapors. Rehn believes that sarcoma of the bladder occurs in some of these cases. The irritation due to hexamethylenamin is more important, since that drug is so freely used nowadays.

While hyperacid urine is somewhat irritating to the bladder, ammoniacal urine is far more so, and the reason why an ammoniacal cystitis is likely to be so much more intense than an acid cystitis is doubtless for this very reason—that the ammonia adds fuel to the fire of bacterial attack.

Cystitis may equally be caused by irritants introduced through the urethra. Nitrate of silver is so often used in concentrated solution that it bears an unenviable notoriety in this regard.

Treatment.—Removal of the cause constitutes the essence of treatment. To allay the irritation the sedative remedies employed in bacterial cystitis may be used.

SIMPLE BACTERIAL CYSTITIS

This is the disease that is generally spoken of as cystitis. It may be acute or chronic, superficial, interstitial, or complicated by pericystitis.

Etiology

The etiology of cystitis has been considered in the preceding chapter. The conclusions therein reached may be summed up as follows:

I. Bacteria may reach the bladder (1) from the urethra, (2) from the kidney, and less often (3) by irruption of a neighboring focus of inflammation, and (4) from the blood or the lymph vessels.

II. Bacteria reaching the bladder will not cause any inflammation of that organ unless there is congestion due to (1) retention, (2) trauma by instruments, stone, or foreign body, (3) disease of the bladder wall, such as neoplasm, tubercle, or simple ulcer, or (4) unless the disease extends directly to the bladder from the neighboring tissues, the ureter or the urethra (gonorrheal cystitis), or (5) unless the bladder is paralyzed.

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[1] *Deutsche med. Wochenschr.*, 1898, xxiv, 709.

III. A cystitis thus begun will disappear spontaneously unless it is perpetuated by some of the accessory causes enumerated. Of these causes the most common, clinically, is retention, which retention is almost always caused by stricture of the urethra, or hypertrophy of the prostate.

IV. Acid cystitis is caused by the bacillus coli, the tubercular bacillus, the typhoid bacillus, or the gonococcus. Alkaline cystitis is due to staphylococcus, streptococcus, or proteus infection.

Pathology

The lesions of cystitis are usually unevenly distributed over the bladder. Indeed, in many acute or mild chronic cases the lesions are entirely confined to the neck of the bladder and the trigone. This so-called inflammation of the neck of the bladder is commonly due to some prostatic inflammation, which latter must be attacked in order to cure the "inflammation of the neck." It may be noted here that in every cystitis, whether acute or chronic, the prostatic urethra as well as the bladder is inflamed, and the vesical inflammation is most intense about the neck and the trigone, unless some special feature of the disease (tumor, stone, pouch) produces a distinct focus of more intense inflammation elsewhere in the organ.

Acute Cystitis.—At first there is a sharp congestion most marked about the trigone and the neck, or entirely confined to that region. The mucous membrane is swollen and bright red in color. The capillaries are dilated, the epithelial cells swollen. Then the epithelial cells begin to desquamate. The angry crimson of the mucous membrane is blotched by petechiæ, its gloss is lost, and here and there minute vesicles or abscesses appear. After these break minute ulcers remain. If the acute condition persists the muscular and peritoneal coats may become involved.

Chronic Cystitis.—The *mucous membrane* is irregularly thickened and dense. Its surface is rough, red or gray in color, perhaps mottled by purple or brownish blotches left by submucous hemorrhages. Here and there may be seen areas of ulceration and granulation. Sometimes the granulations grow to be distinct little villosities several millimeters long. The ulcerations may extend deep into the substance of the organ and communicate (rarely) with abscesses in the muscular tissue. In long-standing cases the epithelium may become cornified in spots, the superficial epithelia being replaced by dense shiny scales resembling the horny layers of the skin (*leukoplasia vesicæ*).

Gross Changes in the Wall of the Bladder.—In prolonged chronic cystitis the wall of the bladder becomes thickened or thinned, its cavity con-

tracted or dilated, its surface thrown into folds of mucous membrane overlying irregular interlacing bands of muscle fiber.

The resulting changes are described as hypertrophy (thickening) or atrophy (thinning) of the bladder. Hypertrophy of the bladder may be concentric (cavity contracted) or eccentric (dilated). The irregularities in the bladder wall are spoken of as trabeculæ (trabeculated bladder) or diverticulæ (sacculated bladder) (Fig. 71; also Pl. I). Diverticulæ extend through the entire thickness of the bladder wall; they may exceed the bladder itself in size. Trabeculation occurs in all cases of prolonged chronic cystitis. Sacculation, whether in a hypertrophied or atrophied bladder, is due to marked retention; but *trabeculation does not necessarily indicate retention,* as every accomplished cystoscopist must realize.

Fig. 71.—Sacculated Bladder. Due to prostatic retention.

Microscopic Changes in the Bladder Wall.—The microscopic changes in the muscle of the bladder afflicted with chronic cystitis have been shown by Ciechanowski to be almost purely sclerotic whether this muscle be thick and apparently hypertrophied or thin and manifestly atrophied. When apparently hypertrophied the increased thickness of the bladder wall is only due in very small degree to actual muscular hypertrophy. It is chiefly due to inflammatory infiltration and sclerosis of the muscle as well as of the interstitial tissue between the bundles of muscle fiber. The so-called " hypertrophied " bladder may be as feeble as the atrophied bladder. The hypertrophy is a false hypertrophy.

The various degrees of hypertrophy and atrophy are due to the interplay of inflammation and retention. If the retention is slight or absent and the inflammation severe, the bladder undergoes concentric hypertrophy. If retention is marked and inflammation severe, eccentric hypertrophy results. If retention is marked and inflammation mild, dilatation and atrophy result.

Pericystitis.—The changes that occur in the connective tissue surrounding the bladder are usually of a protective character. An intense

chronic cystitis often provokes a thickening of the perivesical tissue and of the peritoneum. Less frequently a diffuse fibro-lipoma occurs, comparable to the perirenal fibro-lipoma, and, like it, protective in character. In such cases the fibrous masses may often be felt through the rectum, and I have known them to be mistaken for cancer of the prostate until cystotomy showed the prostate to be normal and the whole bladder to be thickened. When there is much pericystitis the bladder is usually found in a state of concentric hypertrophy with fibrous, undistensible walls.

Suppurative pericystitis is usually due to rupture of the bladder.

Abscess.—Abscess of the bladder is rare. Small abscesses of the mucous membrane may run their course unnoticed. Abscesses within the wall of the bladder may begin in some infected interstitial focus or in a pocket of the mucous membrane. They burst into the bladder, leaving deep necrotic pockets, which may continue to suppurate indefinitely, or lead to perforation of the wall of the bladder. Purulent venous thrombosis has been seen.

Membranous Cystitis.[1]—*Exfoliation of the mucous membrane,* partial or complete, may occur as the result of an intense cystitis or of trauma. It is rarely seen except as a complication of prolonged and difficult parturition.

Symptoms

The three accepted symptoms of cystitis are:

1. Pus in the urine—Pyuria.
2. Frequency of urination—Pollakiuria.
3. Pain, notably pain with urination.

But of these only one—viz., pyuria—is constant. Pus, frequency, and pain may be due to chronic posterior urethritis without cystitis or to pyelo-nephritis without cystitis. If the condition is acute, this triad does indeed suggest cystitis; but *chronic pyuria, frequency, and pain, in the absence of retention, suggest prostatitis or pyelo-nephritis rather than cystitis.*

The pain and frequency of chronic cystitis are due to its cause (stone, retention, etc.) in almost every instance.

Systemic Disturbance.—Though patients suffering from cystitis often exhibit such symptoms as chills, fever, sleeplessness, anorexia, and loss of flesh and strength, these symptoms are not directly referable to the inflammation of the bladder. All the febrile symptoms are due either to inflammation of the prostate or to implication of the kidneys, and the loss of appetite, sleep, and strength is due to the distressing symptoms of pain, dysuria, and tenesmus.

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[1] Cf. O'Neil, *Trans. Am. Assoc. Genito-Urinary Surg.*, 1909, iv.

Having thus briefly summed up the chief symptoms common to all forms of cystitis, we pass to a consideration of the types of the disease—viz., acute cystitis, chronic acid cystitis, chronic ammoniacal cystitis, interstitial cystitis, and pericystitis.

Types of the Disease

Acute Cystitis.—Excepting the acute cystitis of mechanical or chemical origin (p. 351) and the acute exacerbations that occur during the course of a chronic inflammation of the bladder, acute cystitis is almost always of gonorrheal origin. This *acute gonorrheal cystitis* (p. 161) may be accepted as a type of all acute cystitis.

Chronic Cystitis.—Chronic cystitis is very common, so much so that there are few diseases of the lower urinary passages of which it does not form a part. Chronic cystitis, moreover (unlike many other chronic inflammations), rarely commences as an acute disease, but is chronic from the first. It never occurs as an idiopathic affection, but is invariably a secondary result arising from other morbid conditions of the urinary passages (p. 334). Once started, it does not tend to get well spontaneously, but to become slowly and steadily worse. Fortunately, its causes are well known, and most of them easy of demonstration. Many of these can be removed, and with them the chronic inflammation which they keep up. Some cases are incurable on account of permanent structural alterations in the bladder walls, or because the cause cannot be reached; but most may be benefited by careful and judicious management. There may only be slightly increased frequency of urination, with slight cloudiness of the fluid, in very chronic cases; or the calls may be very frequent, and the pains excessive, varied, and constant, as in the acute disease. In fact, chronic cystitis is liable at any time to be lighted up into an acute state by the continued action of its own cause, or by the supervention of other causes (cold, violent exercise, abuse of alcohol, acid urine, instrumentation, etc.). Between these acute attacks the symptoms of the disease are so slight that the patient may fancy himself well, and rejoice over the fancied cure while the spark of future and worse inflammation is yet smoldering within him. Even the physician might be deceived by such a case were it not for the persistent urinary evidence of disease.

The Urine.—The urine in chronic cystitis is clouded by pus and bacteria. It is rarely bloody unless there is tubercle, stone, or cancer. It may be acid or alkaline.

Chronic Acid Cystitis.—When the urine is acid and the cystitis chronic the vesical inflammation is usually mild (unless it be tubercular). The amount of pus in the urine is not great, and the subjective symptoms are slight or entirely absent. This form of cystitis is often

encountered with hypertrophy of the prostate, associated with slight pyelo-nephritis. The inflammation, though mild, is usually quite unconquerable, except by removal of its cause. The dangers connected with it are: (1) The pyelo-nephritis and (2) the development of ammoniacal cystitis, and it is against these that the treatment is chiefly directed. The acid cystitis may be controlled by intelligent treatment, and, if the kidneys are protected and alkaline fermentation prevented, the patient gets along very well at the expense of systematic local treatment.

Chronic Alkaline Cystitis.—This form of chronic cystitis is of serious import. Its severity is usually in marked contrast with the mildness of a chronic acid cystitis. Urination is frequent and painful, the urine foul and ammoniacal (it may be only slightly alkaline) and filled with clots of ropy muco-pus mingled with crystals of triple phosphates and often tinged with blood. A complicating pyelo-nephritis is as common as with acid cystitis; but the symptoms of the bladder inflammation are far less tolerable but easier to control. Unless checked by appropriate treatment the disease tends to grow more severe by successive attacks of acute inflammation, until, finally, the patient succumbs, worn out by his ceaseless agony, or the victim of renal insufficiency.

Interstitial Cystitis.—During interstitial cystitis the bladder gradually contracts down, undergoing concentric hypertrophy, its walls thicken enormously, possibly reaching the thickness of an inch. Abscess may form in them; the cavity becomes nearly obliterated; incontinence ensues; the mass, like a hard, smooth, wooden ball, may be felt in the hypogastrium, or from the rectum. It is not necessarily very sensitive to pressure, and is smooth and of even hardness on its surface. This condition of bladder disease is not curable. The bladder walls cannot be redilated. But removal of its cause will make life bearable for the patient by relieving the pain, even though he still has to urinate frequently.

Diagnosis

Acute Cystitis.—This can be confounded only with acute prostatitis, from which it may be differentiated by rectal touch, which detects a hot, throbbing, swollen prostate in the one case, nothing of the sort in the other.

Chronic Cystitis.—It is a common error to label every case of pyuria "cystitis." This is most fallacious. There may be pus in the urine for years and yet no cystitis. Indeed, the three characteristic symptoms—pain, pus, and frequency—are again and again due to such widely divergent causes as pyelo-nephritis, prostatitis, and vesiculitis without the presence of any cystitis whatever. Another source of misapprehension is the fact that the inflammation of the bladder is often

only an element of the inflammation of the whole urinary tract, in which case its treatment, whether successful or not, has little bearing on the far more important inflammation of the renal pelvis. The physician therefore faces two difficult problems of diagnosis:

1. The existence or the absence of cystitis, and

2. The existence or the absence of pyelo-nephritis, prostatitis, and vesiculitis.

The existence of cystitis may oftentimes be affirmed with certainty without any very searching examination. Thus the clinical features of the cystitis of stone or tumor, or of severe chronic ammoniacal cystitis, are usually quite unmistakable. But, on the other hand, there are a great number of cases showing acid or alkaline urine and more or less characteristic symptoms of cystitis that are not inflammations of the bladder at all. So deceptive are these cases that they may mislead the most expert. Thus Rovsing refuses to accept the diagnosis of cystitis unless it is confirmed by a cystoscopic examination. This is all very well from the bacteriologist's point of view, but for the clinician the cystoscope has its drawbacks; for if a cystitis does exist no manipulation is better calculated than cystoscopy to aggravate the symptoms of the disease. Yet, like many other diseases of the urinary organs, cystitis can only be diagnosed by its physical signs; its symptoms are often most misleading. The physical signs of cystitis are found chiefly in the urine. *When there is cystitis the urine is always purulent throughout* in both the first and the second flow (p. 15). Again, *when the urine is ammoniacal there is always cystitis.* But pyuria does not always indicate cystitis, and ammoniacal cystitis may often be accompanied by pyelitis and other lesions, the diagnosis of which is most important. Indeed, *when the urine is purulent and acid, pyelitis must always be suspected.* Finally, *a chronic pyuria, in the absence of retention, stone, tubercle, or tumor, is due to prostatitis or to pyelitis, not to cystitis.*

Cystoscopic Picture.—The normal mucous membrane of the bladder varies from a deep red over the trigone to a salmon pink in other portions of the viscus. The most important cystoscopic characteristic is the network of red vessels that are visible in the pink mucous membrane. When the bladder is inflamed these vessels are no longer visible, the mucous membrane is reddened, and it may appear velvety, eroded, hemorrhagic, even ulcerated (Pl. I).

Trabeculæ are recognized as interlacing ridges, saccules as deep pockets in the mucous membrane (Pl. I).

Ureter Catheterism.—The cystoscope merely shows that the bladder is inflamed. Intense inflammation about the mouth of one ureter suggests, but does not prove, the existence of pyelo-nephritis on that side.

The existence of pyelo-nephritis, if not shown by the gross urinary signs (p. 377), can be proven only by ureter catheterism.

Differential Diagnosis

As may be inferred from the preceding paragraphs, the positive diagnosis of cystitis is made more often by familiarity with the current causes of cystitis than by the actual symptoms of this inflammation, since similar symptoms are often excited by pyelitis or prostatitis.

If the patient has urethral retention and pus in the urine, we know he has cystitis. If stone in the bladder is recognized by radiography or search, and there is pus in the urine, we know there is cystitis; but under either condition we may be in doubt as to whether the cystitis is not complicated by pyelo-nephritis; and if pus and tubercular bacilli are found in the urine, even though the symptoms be exclusively confined to the bladder, that organ may be entirely sound.

In doubtful cases the diagnosis of cystitis can only be made by cystoscopy, and in no case can the diagnosis of cystitis be made from the symptoms—pus, pain, and frequency—alone.

Urinary Signs.—In some instances, an examination of the urine suffices to exclude cystitis either entirely or as a prime factor in the disease. Thus, bacteriuria is never due to cystitis, and the purulent urine of grave pyelo-nephritis is strikingly different from that of cystitis or posterior urethritis.

Before the days of cystoscopy, great dependence was placed on the irrigation test of cystitis; and, since under many conditions it is impossible to perform cystoscopy, the surgeon who has not this means of diagnosis at his command may be forced to depend upon this test, which is performed as follows:

After the patient has emptied his bladder, a catheter is introduced and the bladder is repeatedly irrigated with small quantities of boric-acid solution until this solution returns absolutely clear of pus. The catheter is then left in the bladder for a sufficient time to gather about 5 c.c. of urine. This urine is then compared with the urine previously passed by the patient. If it is quite as purulent, the existence of pyelo-nephritis may be asserted; if it is less purulent, there is certainly cystitis (or posterior urethritis), possibly pyelo-nephritis; if it is free from pus, there is no pyelo-nephritis, but only cystitis or posterior urethritis.

The distinction between cystitis and posterior urethritis may then be made by injecting a few ounces of boric-acid solution through the catheter, massaging the prostate, and then causing the patient to empty his bladder once more. If there is posterior urethritis, the massage will have increased the amount of pus as compared with that obtained through the catheter before massage.

The precise nature of cystitis, whether it is due to stone, tubercle, tumor, or gonococcus, must be decided by the diagnosis of the different maladies, as described in the various chapters allotted to them.

Prognosis

Acute cystitis recovers spontaneously or under treatment, or becomes chronic. *Chronic cystitis* is curable with its predisposing cause (retention, stone, tumor) or even without it. Thus many cases of cystitis due to prostatic obstruction are cured though the obstruction remains. But they are always in danger of relapse until the predisposing cause is removed.

The danger to life from cystitis itself is slight. Rupture of the bladder, interstitial and perivesical suppuration and sepsis are very remote possibilities. As long as the kidneys remain sound the patient's life is safe.

Treatment

Prophylaxis.—Prevention of cystitis is an important element in the treatment of gonorrhea, prostatitis, stricture, hypertrophy of the prostate, bladder stone, and tumor, as well as in every passage of an instrument into the bladder. It requires no special notice here.

Treatment of Acute Cystitis.—Acute gonorrheal cystitis is the type of all acute inflammations of the bladder, and the treatment of the gonorrheal inflammation (p. 231) is that of all the others. Nitrate-of-silver instillations are not so efficacious in the nonspecific inflammations. If there be any removable cause (catheter tied into the bladder) it should be taken away. If the cause be stone or a foreign body, no attempt should be made to remove it until the intensity of the inflammation has been quieted. If cantharides, turpentine, or cubeb is being taken by the patient, it should be discontinued during the acute stage of the affection, to be resumed in the subacute stage. Asparagus should not be eaten by a patient with acute cystitis; strong coffee and lemon juice should also be avoided. The measures detailed at pp. 209, 338 should be studiously enforced. In all cases repeated use of a full hot bath or a hot hip bath has a soothing effect. The rectum should be kept free by copious warm enemata, and opiates should be given *p. r. n.* Absolute rest and alkaline diluents suffice in mild cases. If abscess form in or around the walls of the bladder, it should be drained through the hypogastrium or the perineum at the earliest possible moment.

Treatment of Chronic Cystitis.—The peculiarity of chronic cystitis, depending, as it always does, upon some other morbid condition, renders its special description unsatisfactory, and begets a necessity for constant reference to the other affections which underlie it. A reference to the pages devoted to the treatment of the inflammation of the urinary tract in general (pp. 338–350), and to the sections on those diseases with which cystitis is especially associated, notably prostatic hypertrophy, stricture, and stone, will give a better foundation for the

treatment of the disease than anything that can be said here. In general, the radical treatment of chronic cystitis consists in removal of its cause. If the cause is not removable, or if it has been removed, the treatment is palliative. Attention to the general health, the urinary hygiene, the condition of the bowels, and the quality of the urine constitutes the essential background, the passive part of the cure, as it were, while the active work is performed locally.

The Urine Must be Modified.—Its specific gravity should be kept below 1.020—below 1.015, if possible. This object is attained by making the patient drink plenty of water. Some balsamic, such as oil of wintergreen, eucalyptus, sandalwood, or turpentine, is administered, together with an alkali. The addition of a urinary antiseptic is especially valuable in prostatic cases, and may be useful in any event. These internal remedies are conveniently put up in soft capsules, each capsule containing a dose. Favorite combinations are:

℞ Ol. santal. flav. ..... 10 gms.
Potass. citrat. ..... 5 "
M. Fiant caps. moll. No. XV.
Sig.—One capsule after each meal.

℞ Salol, Oleoresin. cubeb., Copaiba, Para ..... āā 5 gms.
Pepsin ..... q. s.
M. Fiant caps. moll. No. XV.
Sig.—One capsule after each meal.

℞ Ol. santal. flav., Oleoresin. saw palmetto ..... āā 5 gms.
M. Fiant caps. moll. No. XX.
Sig.—One capsule after each meal.

℞ Hexamethylenamin ..... 5 gms.
Ol. santal. flav. ..... 10 "
M. Fiant caps. moll. No. XX.
Sig.—One capsule after each meal.

Any number of similar prescriptions may be devised. None of them is specific, and I hesitate to lay down any rules for their administration. I am inclined to use urotropin if there is any fever and whenever the kidneys are threatened, and I am never satisfied with any preparation that disagrees with the patient's stomach. It often seems beneficial to change the prescription once or twice a month unless the patient is doing peculiarly well.

Hygiene Must Not Be Forgotten.—The patient must be made to understand the various dangers to be avoided—alcohol, sexual excess, exposure to cold, overexercise, overeating, etc. Some patients are far more sensitive to those influences than others; and older men, especially prostatics, are the most sensitive. But each patient is a law unto himself, and must find out by his own experience those liberties in which he may indulge and those he must avoid. The surgeon can only help him by general suggestions and careful watching.

The Local Treatment Is the Most Important.—This is the active, efficient part of the treatment from which a cure is expected; it must be systematic and intelligent. The more acute or recent the inflammation the more advantage there is in using instillations and in pushing the strength of the solution to the limit of toleration. These cases must be managed by the surgeon himself. I have had most success with nitrate of silver, protargol, and permanganate of potash. Chronic, long-standing cases often cannot be cured unless the cause of inflammation is removed. Ammoniacal inflammation may sometimes be overcome by vigorous local treatment, and the attempt should always be made, as the patient is far safer with chronic acid cystitis than with chronic alkaline inflammation. In most of these chronic cases, however—they are almost all due to prostatic hypertrophy or to stone—the surgeon must be satisfied to hold the disease in check as best he may. The patient is taught to use his own catheter systematically, and instructed in the use of a boric-acid solution for irrigation (p. 311). Any acute phenomena may usually be allayed by a few irrigations with stronger solutions at the hands of the surgeon.

To estimate the results of treatment we have a reliable index in the urine. Months of practice are required before the surgeon is able to estimate the import of urinary showing; but once he has become expert, a glance suffices to tell him whether the patient is better or worse for his last treatment. The two-glass test is always to be used and the contents of the second glass especially noted. If the patient's symptoms are acute or his general condition low, these, too, should react to the treatment; but in the majority of chronic cases the symptoms are so mild that the results of treatment show chiefly, if not entirely, in the urine.

Cystostomy.—Drainage of the bladder by means of a suprapubic or a perineal incision is employed for the relief of inveterate cystitis when other palliative measures fail and the symptoms are too intense to be borne. When the cause of the cystitis is an inoperable tumor, permanent drainage by a suprapubic opening is the only available relief (p. 868). Also, in certain cases of sacculated bladder, interstitial cystitis, and pericystitis, prolonged suprapubic drainage gives the organ the physiological rest it requires in order to rally the forces left to it. If these conditions are not known to exist, cystostomy may still be per-

formed, but it must be recognized to be an exploratory, not a palliative, operation, undertaken for the discovery and removal of the cause of cystitis, not merely for the relief of symptoms. Even if there is interstitial cystitis or pericystitis, an essential part of their operative relief is usually the removal of the urethral obstruction to which the inflammation is primarily due.

The choice between the suprapubic (p. 877) and the perineal (p. 891) route cannot be decided categorically. The safety with which suprapubic cystostomy may be performed in these surgical days, and the excellent opportunity for inspection and palpation of the bladder which this route affords, make the operation above the bone the surgeon's choice in most cases. Permanent drainage can only be obtained by this route.

Of the many forms of tube employed to keep the fistula open I have derived the most satisfaction from the one figured herewith (Fig. 72). It may be made of silver. The tube must be of a sufficient caliber to carry off thick mucus and clots. A short rubber drainage-tube is slipped over the extremity *A*, and this is introduced through the fistula into the bladder. The tube is held in place by a homemade washable belt passing outside the smaller disc (not between the two), and tight enough to press the inner disc firmly against the skin, so that no urine can escape outside the tube. Continuous drainage may be maintained by attaching the outer end of the tube to a leg urinal. If the bladder will contain a little fluid, it is more convenient to cork the tube and allow "hypogastric urination" only at stated intervals. All attempts at obtaining a muscular hypogastric orifice are foredoomed to failure. The corked tube is the best we have. If no tube is employed the fistula narrows down to a dribbling hole which is entirely unmanageable.

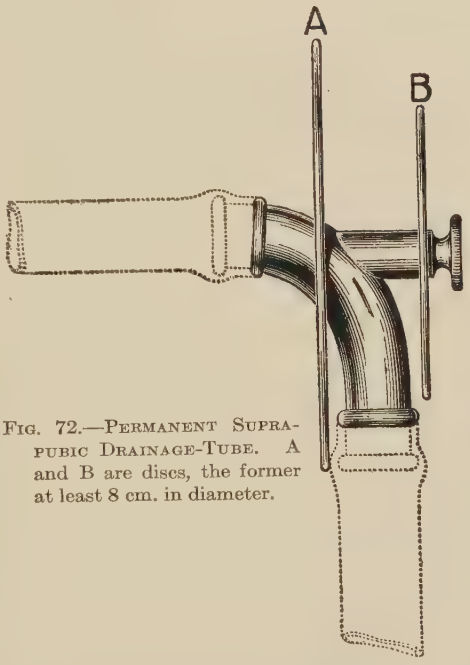

Fig. 72.—Permanent Suprapubic Drainage-Tube. A and B are discs, the former at least 8 cm. in diameter.

For intractable ammoniacal cystitis curettage of the mucous membrane is employed. Kelly even resects portions of the bladder.[1]

If there are diverticulæ, these must be excised.

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[1] *N. Y. State Jour. of Med.*, 1906, April, p. 145.

Treatment of Interstitial Cystitis and Pericystitis.—Interstitial cystitis and pericystitis are usually evidence of a neglected chronic cystitis. The adequate treatment of the inflamed mucous membrane will prevent inflammation of the underlying tissues. Even after interstitial cystitis and pericystitis have appeared much may be accomplished by palliative measures; but oftener operation will be necessary. Cystostomy releases the bladder from the slavery of incessant straining and gives it a needed rest. Perivesical abscesses are to be opened wherever they point. After a suprapubic tube has been worn for some weeks or months the bladder may be ready to resume its functions, and the suprapubic fistula may be allowed to close.

It has been claimed that hydrostatic dilatation will distend a contracted bladder. I have never been able to achieve more than an ephemeral dilatation by this means.

CHAPTER XXXIII

ETIOLOGY, PATHOLOGY, GENERAL SYMPTOMATOLOGY, AND DIAGNOSIS OF RENAL INFECTIONS

No common disease is so persistently and so comprehensively misunderstood as is pyelo-nephritis. The physician, encountering mild chronic cases, is contented with the diagnosis and treatment of chronic interstitial nephritis; while the surgeon is too apt only to see in the pyuria characterizing the severer inflammations an evidence of cystitis. Yet the only way to appreciate the frequency of the disease is *to suspect of pyelo-nephritis every case of bacteriuria or pyuria that is not a urethritis.* Investigation will show that almost every case of long-standing stricture or hypertrophied prostate, and many cases of stone and tumor of the bladder, show some pyelo-nephritis, while occasionally a case will be encountered in which the characteristic symptoms of cystitis—viz., frequent and painful passage of purulent urine—are the sole obvious indications of a suppurating kidney uncomplicated by cystitis.

VARIETIES

The four varieties of pyelo-nephritis are:

Catarrhal pyelo-nephritis (pyelitis).

Suppurative pyelo-nephritis.

Pyonephrosis.

Focal, or hematogenous, suppurative nephritis.

These four conditions constitute the surgical inflammations of the kidney. They represent the various degrees and varieties of suppuration in the kidney and its pelvis. Hence it is convenient to group their etiology, morbid anatomy, and general symptoms all together, leaving the consideration of special symptoms, diagnosis, prognosis, and treatment for the next chapter.

The terms explain themselves. Catarrhal pyelo-nephritis is a light inflammation of the kidney and its pelvis productive of little pus. Suppurative pyelo-nephritis is a similar condition more severe in type, with much pus collected in the pelvis of the kidney and passed off with the urine. Pyonephrosis is suppurative pyelo-nephritis in a dilated kidney.

Focal, or hematogenous, suppurative nephritis is that type of infection which shows itself by the production of multiple foci of suppuration within the renal parenchyma.

ETIOLOGY

The surgical inflammations of the kidney are microbic in origin, and may be caused by any pyogenic bacteria. It is to be remarked, however, that they are habitually caused by the bacillus coli, and are characterized by an acid urine.

The route of bacterial invasion has been noticed in a previous chapter (p. 331). An ascending invasion is accepted as the cause of the inflammation when it is secondary to some disorder of the bladder, prostate, or urethra. But when the renal inflammation is primary it is attributed to infection by microbes excreted through the kidneys—the so-called descending invasion.

Predisposing Causes.—The predisposing causes of pyelo-nephritis are all-important. Bacteria are always present. Every attack of constipation doubtless sends myriads of colon bacilli through the kidneys, and from every infected wound a sufficient number of staphylococci and streptococci doubtless enter the circulation and pass through the kidneys to cause suppuration ten times over in those organs, if only they are vulnerable; but they are not. Unless there is some trauma, irritant, or congestion, the bacteria are passed off without so much as multiplying in the urine. Thus the predisposing cause literally produces the inflammation—more than this, it often determines the quality of inflammation.

The chief predisposing causes are:

1. *Retention.*—Urethral retention, whether by stricture or prostate, is a common cause of pyelo-nephritis and pyonephrosis. Ureteral retention, which usually causes hydronephrosis, may cause pyonephrosis.

2. *Stone.*—Renal calculus is the most common cause of suppurative pyelo-nephritis, and may, by obstructing the ureter, cause pyonephrosis.

3. *Tuberculosis or Neoplasm.*—Malignant or tubercular disease occasions suppuration in the kidney by producing a tissue ill fitted to repel bacterial invasion, and by blocking the ureter.

4. *Trauma.*—If a contused or ruptured kidney becomes infected there results a suppurative pyelo-nephritis or abscess of the kidney, or both.

5. *Other Causes.*—Among these may be mentioned the pressure of pelvic growths, pregnancy, decrease in the power of resistance, such as occurs in wasting diseases, and especially in tabetics and paralytics, and such septicemias as overwhelm the kidneys by the multitude of microbes these organs are called upon to transmit (e. g., typhoid).

PATHOLOGY

It is customary to describe pyelitis and nephritis as though they were quite independent conditions, or at least often met with separately. Such is not the case. While doubtless the inflammation has its first beginning in the one or the other, it is impossible clinically to distinguish pyelitis without nephritis or nephritis without pyelitis, excepting only those rare cases of renal abscess which begin within the parenchyma of the kidney and do not implicate the pelvis. With this one exception, then, suppurative nephritis does not occur without pyelitis, nor does pyelitis, whether catarrhal or suppurative, occur without nephritis.

The Renal Pelvis.—**Catarrhal Pyelitis.**—When the pelvis of the kidney is acutely inflamed it is congested and may be covered with a layer of pus or false membrane. There may be petechiæ and spots of epithelial desquamation.

In chronic conditions the pelvis is thickened and its mucous membrane rough and bereft of its normal polish.

Suppurative Pyelitis.—Suppurative pyelitis is characterized by more important changes. Besides a considerable inflammatory thickening of its walls, and more or less ulceration of its surface, the very shape of the pelvis may be distorted. There is often sufficient pouching of its sides to allow the accumulation of pus and calculi in a sort of pocket which, like the *bas fond* of the bladder, is the microbic breeding-place—the source of the pus.

The ureter is usually inflamed throughout its length in severe or acute cases.

Pyonephrosis.—In pyonephrosis the pouching and dilatation of the kidney pelvis reach their limit. The pelvis is usually greatly thickened and dilated, and is often irregularly pouched (Fig. 73), ulcerated, and filled with pus, calculi, or a magma of lime salts. The ureter is dilated, if the obstruction is urethral, or itself kinked, stenosed, or obstructed.

The Kidney.—**Catarrhal Nephritis.**—A light bacterial infection does not necessarily provoke suppuration in the kidney. The bacteria (usually the bacillus coli) obtain a foothold, probably in the mucous membrane of the calices, and thence attack the whole kidney, not by suppuration, but by chronic interstitial sclerosis.

The kidneys become small and dense, slightly lobulated on the surface, with adherent capsule, and perhaps a few small cysts with serous or sero-purulent contents. On section the cortex is found chiefly affected. While the pyramids retain a normal appearance the cortex may be quite converted into a mass of fibrous tissue containing lobules of fat. The microscope reveals infiltration of the stroma with fibrous and

fatty tissue compressing and obliterating tubules and glomeruli alike. The areas of sclerosis are unevenly distributed about the organ, and wherever there is no sclerosis the secreting epithelium undergoes hypertrophy.

The difference between the lesions just described and those of renal retention (cf. Hydronephrosis) must not be forgotten. *Retention alone causes* congestion and edema first, later epithelial *atrophy without any production of new interstitial tissue; while inflammation,* whether catarrhal or suppurative, whether associated with retention or not, *causes chronic interstitial nephritis* with a temporary acute congestion if the onset of the nephritis is acute.

Suppurative Nephritis.—Inasmuch as no two suppurating kidneys present exactly the same lesions it is quite impracticable to give a detailed picture fitting the requirements of every case. In general it may be said that—

1. There is always more or less of the chronic interstitial change described above.

2. In chronic suppurative pyelo-nephritis the kidney is habitually enlarged and congested, while the sclerosis is marked and the suppuration may be confined to the surfaces of calices; or there may be one or more foci of suppuration within the kidney substance, or dense globular scars showing where abscesses have been.

Pyonephrosis.—In pyonephrosis the kidney is commonly reduced to a dense multilocular abscess cavity (Fig. 73) containing pus, perhaps urinous or cheesy, and usually calculi. The loculi may intercommunicate widely or may be quite shut off, forming separate abscesses. Albarran mentions the occurrence of large subcapsular abscesses. Yet, in spite of all this sclerosis and chronic suppuration, the pyonephrotic, like the hydronephrotic, kidney almost always retains some epithelial elements and some power of secretion. Yet, in discussing the treatment of this condition, we shall see that the conservatism with which this should inspire the surgeon is often more than outweighed by the dangers of leaving a suppurating kidney and the inconvenience of secondary nephrectomy.

FIG. 73.—PYONEPHROSIS. The kidney is reduced to a multilocular suppurating cavity.

Focal Suppurative Nephritis.—The kidney is greatly congested, and shows a diffuse or localized tendency to the formation of miliary abscesses, chiefly in the cortex. The pathologic conditions found, depending upon the duration and intensity of the infection, are as follows:

(1) The patient may die with congestion of the kidneys before any suppuration has taken place. The parenchyma is crowded with bacteria. Albarran has described such cases.

(2) Usually multiple miliary abscesses form in but one kidney. They are grouped or diffusely scattered over the cortex (Fig. 74).

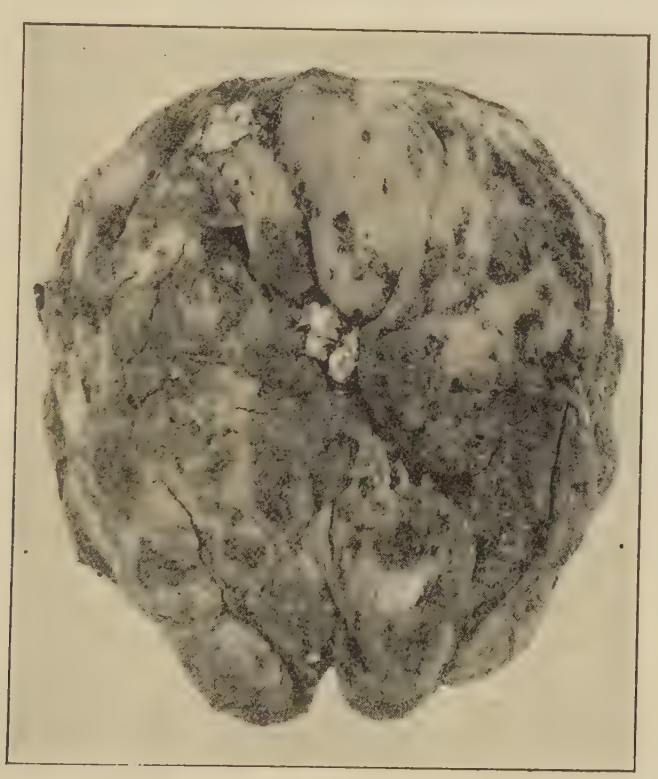

FIG. 74.—FOCAL SUPPURATIVE NEPHRITIS. The kidney is split and seen from without. It is mottled by groups of miliary abscesses. Vessels and ureter in center.

(3) If the patient survives the sepsis from this condition, portions of the parenchyma between the abscesses break down, the abscesses coalesce into one or more large foci and these rupture either into the pelvis or into the perirenal tissues.

The Perinephritic Tissue.—**Fibro-lipomatous perinephritis** (p. 401), characterized by condensation of the perirenal fat into a dense fibro-lipomatous envelope, is constantly met with in severe cases of long

standing, while some fibro-lipomatous masses are found about the pelvis in almost all cases.

Suppurative Perinephritis.—The result of irruption or extension of a renal or other abscess into the perinephritic tissue is described in Chapter XXXVI.

The Opposite Kidney.—Catarrhal pyelo-nephritis is habitually bilateral, and it is common for a catarrhal pyelo-nephritis to occur in the fellow of a kidney affected by any extensive suppuration.

Toxic parenchymatous nephritis may result in the opposite kidney from absorption of the products of suppuration in its fellow. This lesion is rarely of any importance except in tubercular cases (p. 456).

Compensatory hypertrophy of the opposite kidney occurs, proportionate to the amount of extra work forced upon it.

Other Organs.—Urinary Organs.—When the kidney is primarily inflamed the infection is spoken of as "descending," though, as a matter of fact, it is not common for the inflammation to descend to the bladder. Indeed, the patient often seems singularly immune from the consequences that might be anticipated from the zealous soundings and washings to which he is so often subjected. In spite of purulent urine and surgical trauma Nature for once is kind, and tries to spare the prostate and bladder.

When the prostate and bladder are primarily infected, the renal infection is spoken of as "ascending."

Other Organs than Urinary.—The cardiac hypertrophy of renal sclerosis is encountered. The digestive disorders are apparently toxemic and functional. Septicemia and pyemia are possible complications.

LOCAL SYMPTOMS OF RENAL INFECTION

The local symptoms of renal infection are:

Urinary Signs.
Pain and Tenderness in the Loin.
Lumbar Mass.
Disorders of Urination.
Other Reflex Pains.

Urinary Signs.—The urinary signs of renal infection are sufficiently described with the diagnosis at the end of this chapter. Suffice it to state here that in almost every chronic case the urinary signs are for a long period of time the only evidence of disease, in some cases for all time.

Pain and Tenderness in the Loin.—To cause pain and tenderness an inflammation must excite tension. Hence acute renal infections always excite renal sensitiveness and, if severe, spontaneous pain. Hence, also, the general rule that a febrile renal infection excites costo-vertebral ten-

derness. But chronic mild infections excite neither symptom. Thus Chute,[1] in examining 40 cases, obtained a history of pain in all the acute cases and in only half of the chronic ones, and elicited costo-vertebral tenderness in all the acute cases and in only 9 (26 per cent) of the chronic ones. The pain and tenderness are sometimes referred to the opposite kidney (see below).

The pain and tenderness may be much more marked in front than behind if the tension is in the pelvis rather than in the kidney itself. They radiate downward in the course of the ureter, or down the thigh.

Lumbar Mass.—A kidney may be completely disorganized by suppuration without being greatly enlarged, and so many elements, such as adhesions, avoirdupois, and abdominal rigidity, combine to render palpation of the kidney difficult, it is not surprising to find that Chute could palpate definite enlargement of the kidney in only 11 cases. It is notable that twice the normal kidney seemed enlarged, a fact which Chute attributes to compensatory hypertrophy.

Disorders of Urination.—That 34 of Chute's 40 cases had painful or frequent urination is a striking confirmation of the importance of this symptom of renal infection.[2]

The disturbance of urination is much more marked at night only if there is nocturnal polyuria; but it is often equal day and night, rarely purely diurnal.

Other Reflex Pains.—The pain may be referred to various inexplicable regions. Of importance is the so-called reno-renal reflex, the reference of pain from the diseased to the sound kidney. Morris denies the existence of this reflex, and I have certainly never seen it. The few cases in which I have known unilateral renal infection to be accompanied by pain in the opposite loin have been explicable by the existence of marked seminal vesiculitis on the painful side. Yet, clinically speaking, this "crossed" pain is not excessively rare and, whether due to physiological congestion of the overworked sound kidney, or to some such cause as spermatocystitis, or actually to a reno-renal reflex, is relatively unimportant. The fact remains that the painful kidney, and even the tender kidney, may be the normal kidney. Chute found "crossed" pain once, "crossed" tenderness twice.

GENERAL SYMPTOMATOLOGY

The general symptoms of surgical renal infection may be due to autointoxication from renal insufficiency (urinary toxemia) or to ac-

[1] *Boston Med. and Surg. Jour.*, 1908, September 17.

[2] In 28 of these 34 cases the cystoscope revealed bladder involvement, but in only 9 was this cystitis of any importance.

tual septicemia or pyemia. We need not here concern ourselves with that special and peculiar form of urinary toxemia occurring when both ureters are suddenly and completely obstructed (see Calculous Anuria).

Urinary Toxemia

Urinary toxemia is a chronic autointoxication due to renal insufficiency—i. e., to the inability of the diseased kidneys properly to perform their function of eliminating certain excrementitious substances from the circulation. This condition is common to all the diseases of the renal parenchyma, whether medical or surgical. It is usually called uremia, a misleading term, for which should be substituted the more accurate title, urinary toxemia, which serves to distinguish it clearly from urinary septicemia; while at the same time it does not hint, as uremia does, that the retention of urea (itself a diuretic) plays any part in causing the symptoms.

Etiology.—The causes of urinary toxemia are all reducible to one condition—viz., inability of the renal epithelium to perform its function. This the surgeon encounters in an acute and a chronic form.

Acute urinary toxemia occurs as (*a*) acute post-operative renal congestion, and (*b*) acute reflex renal congestion after operations, etc., upon the urethra and bladder.

Chronic urinary toxemia may occur from the chronic congestion of urinary retention—be it urethral, prostatic, or ureteral—or from chronic interstitial nephritis. In practice the two causes act together. The congestion of retention permits infection; that, in turn, causes interstitial nephritis, and the congestion continuing hastens the functional dissolution of the diseased organs.

Symptoms.—The symptoms of urinary toxemia, whether acute or chronic, are those commonly described in text-books on the practice of medicine as the symptoms of uremia. The picture in acute cases is anuria (or oliguria), autointoxication, and death—unless, perchance, the attack subsides spontaneously or the surgeon intervenes. In chronic cases, when the surgeon sees them, the symptoms of chronic urinary toxemia are commonly intermingled with and obscured by those of urinary septicemia.

Urinary Septicemia

Urinary septicemia is septicemia arising from the absorption through the kidneys of bacterial products in the urine. It is due to the retention of infected urine. Therefore it always includes urinary toxemia, and to this are due some of its peculiar features.

Many forms of septicemia and pyemia result from diseases of the genito-urinary organs. A prostatic abscess, a periurethritis, an infil-

tration of urine, a suppurating testicle (to mention only a few of the more notable causes), may and do set up generalized infection. But this is not *urinary* septicemia.

Occurrence.—Urinary septicemia results from retention of purulent urine. It is most commonly encountered in cases of prostatic hypertrophy. Old, tight strictures evoke it, and it always occurs with pyonephrosis and suppurative pyelo-nephritis.

Pathogenesis.—It will be observed that urinary septicemia is always due to changes in the kidneys. Any renal suppuration in which there is accumulation of pus in the kidney inevitably gives rise to urinary septicemia. On the other hand, urethral stricture and prostatic hypertrophy cause urinary fever only by producing renal retention and suppuration.

Symptoms.—The symptoms of this condition may be grouped under several heads—viz.:

Fever.—The fever of urinary septicemia is as irregular as that of any septicemia. When acute it may be interrupted by successive chills, or it may merely run high in the afternoon and low in the morning. In mild chronic cases there may be but a slight afternoon rise, with perhaps a subnormal temperature at night, while occasionally the temperature may remain subnormal for days at a time.

Circulation.—The circulatory conditions vary through an equally wide range. The heart may show the feebleness of age or the hypertrophy of chronic nephritis. If the patient is robust the pulse is rapid and tense, and as he fails it may grow more so, or it may become weak and thready. Arterial sclerosis is a common complication in long-standing cases.

Digestive Organs.—The condition of the digestive organs is usually characteristic. The bowels are constipated, the appetite poor, and, while any acute indigestion is unlikely, that general digestive discomfort common to every form of autointoxication is met with here. Nausea, vomiting, and hiccough are symptoms of grave uremia. A foul diarrhea may bespeak intense poisoning. *In severe cases the condition of the tongue, mouth, and fauces is pathognomonic. The tongue is bright red* [1] on its tip and sides, while the dorsum is coated and brown or grayish (Plate V). The entire organ, indeed *the entire mouth and fauces are dry and parched.* The saliva is diminished in quantity, viscid in consistence, and acid in reaction. In the last stages of the disease the foul breath, the sordes, the cracked, parched tongue, brown in the center and bright red all about, form a characteristic and repulsive picture.

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[1] The *redness* and dryness of the tongue are directly due to the renal condition and are therefore constant, while the *coat* is attributable to the digestive disturbance and is therefore variable, or may even be entirely absent.

The result of this condition of the mouth and tongue is the *buccal dysphagia*, first described by Guyon. On account of the dryness of his mouth the patient accepts with avidity all fluids, but has an aversion to solids, which he can masticate and swallow only with considerable discomfort.

Uremic Symptoms.—Drowsiness and torpor are often the earliest uremic symptoms. Later the drowsiness may deepen, or may alternate with or give place to a mental restlessness with wanderings and hallucinations, whence the patient may at first be recalled, though later he goes into a permanent maniacal or comatose condition. At the same time hiccough and persistent vomiting are likely to occur, with absolute constipation or severe diarrhea—and then the end.

The Patient's Aspect.—When a patient comes complaining of his bladder or kidneys a glance will reveal the presence of urinary septicemia to the experienced eye. His face is usually thin, drawn, and sallow, or, if fat, flabby and pasty. There is a history of failing digestion and lost weight. The skin is dry, perhaps feverish. There may be a slight edema of the extremities, but this symptom is often notable by its absence. The actions of the man betoken lassitude, even stupidity.

Types of the Infection.—Urinary septicemia manifests itself in one of four types—viz.:

Urethral Chill.
Acute Urinary Septicemia.
Chronic Urinary Septicemia.
    Dyspeptic Type.
    Septic Type.

Urethral Chill.—Urethral chill is an arbitrary title for that form of acute urinary sepsis excited by the passage of a urethral instrument. Clinically, it usually consists of a single sharp chill occurring immediately after the first urination following instrumentation; the temperature rises to 103° or 104° F., and within an hour falls again to normal amidst profuse perspiration.

This usually constitutes the whole attack, but it may be the onset of acute urinary septicemia.

The older authors, overlooking the presence of mild chronic pyelonephritis, invoked fanciful neurotic explanations of urinary chill. As a matter of fact, the victim of urinary chill always has some preëxisting lesion of the kidneys, usually a pyelo-nephritis. The chill is an expression of acute renal congestion, in part perhaps reflex, but chiefly due to absorption of bacteria from the lacerated urethra.

That urethral chill does not occur more constantly under similar conditions is the mystery. The majority of patients escape, whether the urine is infected or not, whether the wound or the trauma be great or

small. The same patient may have a chill one day, and escape it after an exactly similar operation on the next. The simple gentle passage of a small, soft bougie may give rise to it, while violent divulsion or urethrotomy, performed a day or two afterwards, may evoke no reaction; and again, after divulsion, which has been negative, the passage of a steel sound may produce a chill. Moreover, the position of the injury inflicted by the instrument is of importance. At and near the meatus the most serious injuries do not give rise to chill, though decomposed urine pass freely over the raw surface. The danger increases in proportion to the depth at which the injury is inflicted.

Diagnosis of Urethral Chill.—Urethral chill must be distinguished from urethral shock. Mild urethral shock is seen typically upon the first passage of an instrument. The patient, usually of a nervous type, fearful of all manipulation, complains of great pain from the unobstructed and gentle introduction of a sound into his bladder. Immediately he feels faint and nauseated; he may vomit or faint away; his skin is cold, pale, and dry, his pulse weak, rapid, or irregular. He may have a slight chill, and as the attack passes the skin becomes flushed and moist. Such a paroxysm lasts but a few moments.

Exceptionally, the collapse is unduly severe and prolonged, and the patient dies.

Such death is usually attributable to cocain poisoning or to *status lymphaticus*.

Acute Urinary Septicemia.—This may occur without known provocation or may follow urethral chill. It is due to focal suppurative nephritis. It is characterized by high and irregular fever, perhaps interrupted by repeated chills. The kidneys are sensitive to pressure. Subjective renal pain may be slight or, if severe, referred to the region of the gall-bladder or appendix. The course of the inflammation is that of focal suppurative nephritis (p. 369).

Chronic Urinary Septicemia.—This is urinary septicemia as encountered in everyday practice. It rarely begins as an acute septicemia. Its onset is habitually gradual, even obscure. The various symptoms that combine to make up the picture of this disease have been described above. Two classes of cases are encountered—viz.:

Dyspeptic cases, in which the patient complains solely or chiefly of his digestive disturbance. Such are the old men who suffer from prostatic retention, with little inflammation and little irritability. They recognize only that they are failing, losing weight and strength, becoming more and more drowsy, and utterly dyspeptic. They present the characteristic tongue, and show slight irregularities of temperature and some polyuria. Relief of the prostatic retention cures the symptoms, unless, perchance, the surgeon's efforts, catheteral or operative, result in provoking the septic type of chronic urinary septicemia. If let alone

these patients deteriorate slowly, and, if not carried off by intercurrent disease, pass finally into the septic type.

The septic type of chronic urinary septicemia is the grave condition that precedes the fatal termination of any chronic retention and suppuration in the bladder or kidneys. It may last for years, or death may close the scene within a few weeks of its onset. While the mildness of its symptoms may at first contrast vividly with those of urethral chill or acute urethral septicemia, it is in still more marked contrast to them, in that it always terminates fatally if left to itself. The approach of the fatal issue is betokened by accentuation of the polyuria and buccal dysphagia, and by the appearance of vomiting, hiccough, and diarrhea.

DIAGNOSIS

Taken in the order in which they are usually applied, the diagnosis of surgical inflammations of the kidney is founded on the following tests, viz.: history of the case, evidences of septicemia, palpation of the kidneys, examination of the urethra and prostate, urinalysis, cystoscopy, and ureter catheterism. But in order of importance this list should be reversed. It is true, the very look of an old man who complains of nocturnal urinary frequency, or of a young man who complains of difficult urination following a chronic gonorrhea, may convict him of renal suppuration. But most cases of renal infection are revealed only by careful urinalysis, and many elude any test less precise than ureter catheterism. Moreover, the ureter catheter is often essential to distinguish the precise condition of each kidney as contrasted with its fellow.

Method of Diagnosis.—Every patient with pus in the urine is suspected of pyelo-nephritis until his kidneys are proven normal. Every suspect should be submitted to the following examination:

Careful review of the history and person with special reference to gonorrhea, stricture, prostatism, stone, tuberculosis, pregnancy, and fever.

Examination of the urine passed into two glasses. If the patient's temperature is normal and the second flow of urine is *absolutely* free from pus and bacteria, he has no renal infection (unless the infection is being controlled by treatment). But if there is fever, the total absence of pus, blood, and bacteria from the urine does not absolutely exclude the presence of focal suppurative nephritis; this is disclosed, however, by costo-vertebral tenderness.

Palpation of the kidneys, as described in Chapter I.

Examination of the urethra and prostate for evidence of obstruction.

Radiography, if stone is suspected.

Cystoscopy and ureter catheterism, if the preceding tests are unsatisfactory and inadequate, and if the patient's circumstances and condition permit, and the diagnosis requires it.

THE URINE OF GRAVE SUPPURATING PYELONEPHRITIS.

The urine is acid and milky when passed. On standing it becomes almost clear, retaining only a bacterial haze, while the pus accumulates in a flat, cohesive, yellow or greenish mass at the bottom. The specific gravity of this urine is low, and the amount of pus varies from day to day.

Urinary Signs of Renal Infection.—Excepting only (1) cases of catarrhal pyelo-nephritis under control of treatment and (2) exceptional cases of focal suppurative nephritis, the urine of a patient with an infected kidney always contains bacteria, usually pus, often blood, rarely casts, always albumin. It is commonly acid, and may or may not show lowered specific gravity due to a lessened excretion of solids.

Bacteria.—These are always present. The commonest bacterium is the bacillus coli, alone or combined with pyogenic cocci. The renal flora may be contaminated in the bladder.

Pus.—Pus is present unless the case is a pure bacteriuria. Microscopically, the pus cells are often found distorted, but this distortion is neither constant nor characteristic. Macroscopically, the pus may be so slight as to be obscured by the bacteriuria, or it may be light and in no great quantity, indistinguishable from the pus of cystitis or posterior urethritis. But grave pyelo-nephritis or pyonephrosis delivers a quality of pus recognizable to the naked eye as "renal pus." If, in such cases, the urine is closely watched, it will often be found to remain for days almost clear of pus, during which period the patient's general and local symptoms become progressively more marked. Then, suddenly, and without assignable cause, the urine becomes loaded with thick creamy pus and immediately the symptoms are relieved—only to recur gradually as the pus pocket in the renal pelvis refills. This symptom-complex, of *markedly remittent pyuria with increasing symptoms while the pus collects and relief when it is poured out,* is almost pathognomonic of pyonephrosis or grave pyelo-nephritis. The seminal vesical or a bladder saccule may give similar gushes, but the symptoms and the local and urinary signs of these conditions differ so widely that an error of diagnosis is hardly possible.

But the gushes of pus are not constant, and to distinguish them may require long and careful observation. Yet if there is at any time a considerable quantity of renal pus in a given specimen, its characteristics are usually quite distinctive. If the urine is allowed to stand an hour or so in a glass vessel, it will be found that *the pus sinks to the bottom of the glass and lies flat and solid like a bed of sand, while the supernatant fluid remains hazy with bacteria* (Plate IV). The pus has often a sallow greenish hue, or it may be creamy; but these signs are of little moment. It is the flatness and solidity of the deposit that are characteristic. Bladder pus never settles in this way. However intense the cystitis, however deep the layer of pus at the bottom of the glass, it is always capped by a fluffy, rolling muco-cloud (like the thunderheads on the horizon of a summer sunset) if the pus comes from any part of the urinary tract except the kidney.

Blood.—The blood, if present, is usually microscopic, unless there is stone, tubercle, or tumor. The blood cells may be crenated or distorted,

but this is not characteristic. If clots appear, they are small or elongated (ureter casts), quite different from the great clots that form in the bladder. If the hematuria is macroscopic, it is evenly distributed throughout the urine.[1] In color the blood is usually dark, but may be as light as a vesical hemorrhage.

Casts.—Any variety of casts may appear, but *chronic renal infections often show no casts at all.* I have followed for several years the urinary analyses of a case of chronic pyelo-nephritis of some twenty years' duration: not one in 10 of them reveals casts. Chute found casts in only 7 out of 40 cases of renal infection.

Albumin.—The presence in the urine of more than a trace of albumin, in the absence of blood or of acute prostatitis, is almost certain evidence of renal infection. Yet most cases of chronic pyelo-nephritis show but a trace of albumin.

Acidity.—The urine of pyelo-nephritis is usually acid, unless contaminated by an alkaline cystitis. Alkaline pyelo-nephritis is usually calculous.

Lowered Excretion of Solids.—Retention of urinary solids is, of course, proportionate to the degree of renal destruction, but, inasmuch as grave renal infection is often unilateral and excites compensatory hypertrophy in the opposite kidney, the total urine may show no reduction of solids, though the urine obtained by ureter catheter does show this.

Cystoscopic Picture.—General cystitis may or may not be present. If so, it usually obscures the cystoscopic signs of pyelo-nephritis. If not, the following conditions may obtain:

There may be no evidence of pyelo-nephritis discernible by the cystoscope. This is the case in the majority of light chronic renal infections. The ureter mouth is normal, its contractions regular. I have even seen the mouth of a ureter from a markedly tubercular kidney look and act quite normally (Plate I).

There may be localized cystitis. Inflammation of the bladder mucous membrane about the mouth of a ureter is suggestive of inflammation in the corresponding kidney, even though that ureter mouth itself be not notably diseased.

The ejected urine may be purulent. A kidney that is actively suppurating may secrete so purulent a urine that its cloudiness is readily recognizable as it issues from the ureter.

The jet may be deficient. If the urine drools from the ureter mouth instead of being ejected by a sharp ureteral contraction, there is grave impairment of the ureteral function, and presumable renal infection. In such cases, however, the ureteral mouth is usually manifestly diseased, and the jet notably purulent.

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[1] A few cases of terminal renal hematuria have been alleged.

The mouth of the ureter may be diseased. The inexperienced cystoscopist finds either distortion or congestion in every ureter mouth he sees. The experienced operator mistrusts apparent congestion of the ureter mouth quite as he mistrusts long intervals between the ureteral jets. Neither is a safe sign of disease.

Disease of the ureter mouth may show itself by ulceration on or near the lip of the ureter, or merely by the circumscribed periureteral cystitis already mentioned. In many instances, however, chronic ureteritis produces actual distortion of the orifice (Plate I).

The diseased ureter orifice may be contracted; it is oftener dilated. Dilatation is usually associated with circumjacent cystitis, often with rigidity. The rigid dilated ureter mouth is often round in shape, the "golf-hole" ureter. The most dilated ureter orifice I ever saw was not rigid, but emptied itself with a sort of prolapse of a hemorrhoidal-like tab of mucous membrane (the kidney above was pyonephrotic).

In most cases the precise condition of the kidney is best determined by ureter catheterism.

CHAPTER XXXIV

CLINICAL TYPES OF RENAL INFECTION: THEIR SYMPTOMS, COURSE, DIAGNOSIS, AND PROGNOSIS

The following types of renal infection will be here considered:

Acute Catarrhal Pyelo-nephritis. (Acute Pyelitis.)

Chronic Catarrhal Pyelo-nephritis. (Renal Bacteriuria—and with this a consideration of bacteriuria in general.)

Suppurative Pyelo-nephritis.

Pyonephrosis.

Focal Suppurative Nephritis. (Multiple Septic Infarcts.)

Renal Infections of Childhood and Pregnancy.

ACUTE CATARRHAL PYELO-NEPHRITIS

This inflammation is characterized by total bacteriuria, fever, and a few local symptoms. It is caused almost exclusively by the Bacillus coli communis and the typhoid bacillus. It occurs during pregnancy or in the course of a typhoid fever. It may also be the first stage of many ascending renal infections.

It is an ephemeral inflammation. I have known it to begin with repeated chills and a sharp rise of temperature, though it may commence less acutely. In the few cases I have seen the temperature ran a septic course, low in the morning, high in the evening, and was associated with little prostration and no evidence of urinary toxemia or septicemia. After a few days the temperature runs lower, and becomes normal between the fourth and the fourteenth day.

Meanwhile *the local symptoms amount to nothing more than a very slight ache and tenderness in the loin.* The urine, however, shows a characteristic acid total bacteriuria and contains albumin and casts.

As the acute inflammation subsides, it is possible for the infection to be overcome spontaneously and for the kidneys to return to their normal state. Otherwise chronic catarrhal or suppurative pyelo-nephritis or focal suppurative nephritis supervene.

Diagnosis.—Acute catarrhal pyelo-nephritis is not an uncommon inflammation, but it is usually overlooked. When it occurs in the course

of a pregnancy, the obstetrician recognizes the albuminuria, but pays no attention to the bacteriuria. The fever, if low, is overlooked; if high, it is misinterpreted. The inflammation soon becomes chronic, and so continues indefinitely, or disappears without any diagnosis or treatment other than that of puerperal nephritis.

The acute catarrhal pyelo-nephritis of typhoid fever is also misinterpreted. Whatever rise of temperature or albuminuria it causes is attributed to the enteric inflammation, and the bacteriuria is treated and cured without any clear recognition of the nature of the lesion.

Acute catarrhal pyelo-nephritis occurring in the course of a cystitis is still more obscure. The urinary evidences of cystitis overshadow the renal bacteriuria, and the general and local symptoms are not sufficiently definite for a diagnosis. Hence the renal inflammation is overlooked until the cystitis is controlled and the pyelo-nephritis has become chronic.

To diagnose acute pyelo-nephritis it is only necessary to distinguish the symptom-complex of bacteriuria, albuminuria, and fever. This can usually be done in the puerperal cases, sometimes in the typhoidal cases, and rarely in the cases of ascending infection.

Ureter catheterism and costo-vertebral tenderness clinch the diagnosis.

CHRONIC CATARRHAL PYELO-NEPHRITIS

The symptoms of chronic catarrhal pyelo-nephritis are acid renal bacteriuria and urinary toxemia. In the earlier stages of the disease bacteriuria is the only symptom, but as the renal sclerosis advances the evidences of kidney insufficiency gradually appear. There are no local symptoms.

I suspect that chronic catarrhal pyelitis always begins acutely or remains as the last trace of a suppurative inflammation of the kidneys. Yet I have encountered many cases that gave no history of either origin. The inflammation is habitually encountered as the result of stricture or of prostatic hypertrophy. In many such cases the cystitis may be conquered, leaving the patient with no evidence of disease other than the passage of acid bacterial urine containing casts, a mere trace of albumin, and a few pus, blood, or epithelial cells. Less frequently a chronic catarrhal pyelitis persists after pregnancy or typhoid fever. In other cases the catarrhal pyelitis originates as a suppurative inflammation. After the kidneys have been thoroughly emptied of pus, an acid renal bacteriuria still persists.

The course of the inflammation is much the same whatever its origin. It may resolve spontaneously or under treatment during the first months. The typhoid cases usually resolve, while those originating from a retention cystitis or from suppurative pyelo-nephritis very rarely do.

At first it gives no subjective symptoms. Unless the patient's attention is called to his urine by its haziness or its odor, he is quite unconscious that there is anything wrong with him. But interstitial sclerosis of the kidney is a constant feature of the inflammation, and this may ultimately carry the patient off, though I confess I have not known it to do so. The cases I have watched have remained entirely quiescent or been interrupted by acute attacks of pyelo-nephritis or of focal suppurative nephritis.

Diagnosis.—The diagnosis of chronic catarrhal pyelo-nephritis is the diagnosis of bacteriuria and of chronic interstitial nephritis. Both diagnoses are essential to appreciate and treat the case. If it has originated in a chronic cystitis, the surgeon is peculiarly prone to neglect the kidneys and to torture the bladder with syringes, cystoscopes, sounds, and section in vain efforts to check the inflammation that is in the pelvis of the kidney. A careful urinary examination and cystoscopy will set him right.

On the other hand, the general practitioner will be quick enough to appreciate the renal aspect of the case, but, through neglect to note the obvious haze in the urine, he overlooks the bacterial cause, and all his medical treatment avails nothing. The diagnosis of chronic catarrhal pyelo-nephritis is simple enough, if one only suspects its existence.

BACTERIURIA

The one form of urinary infection that does not lend itself readily to classification is bacteriuria—the presence of great numbers of bacteria in the urine without obvious parietal lesion. It can scarcely be termed an infection of the urine without any lesion of kidney, bladder, or prostate. Such a theory, though it has been generally accepted, is opposed to all we know of urinary bacteriology. We know that the simple injection of bacillus coli into the bladder does not cause bacteriuria. We know that the simple passage of bacillus coli, even in great numbers, from the kidney does not cause bacteriuria. We know that bacteriuria is often only an initial or a terminal phase of cystitis or pyelo-nephritis. We know, finally, that in many cases the bacteriuria may be temporarily conquered by vigorous treatment only to reappear again as soon as the treatment is remitted. In view of these facts it is not possible to accept the old theory that bacteriuria is due to the presence in the urine of a microbe which multiplies so fast that it is not swept away by the urinary stream. On the contrary, we can only conclude that bacteriuria is a collective term covering several different conditions whose salient characteristic is the rapid multiplication of bacteria, so that they swarm in the urine and are associated with little or no pus to indicate the existence of the local inflammation from which they take their origin. It is not

just to restrict the term bacteriuria to those cases in which the urine contains no demonstrable pus whatever, for a little pus may appear in one specimen of urine and be absent from the next.

Bacteriuria has been studied at length by Roberts,[1] Krogius,[2] Rovsing,[3] Jeanbrau,[4] Gassman,[5] and others.

Symptoms.—*The Urine.*—The urine of bacteriuria is hazy. It contains no gross particles or cloud of pus, but seems to be filled with the finest sort of a white powder. In a strong light the urine has a peculiar opalescence. Its reaction is acid in the great majority of cases. Its peculiar sickening odor has been compared to that of a mouse or a dead fish. No deposit occurs on standing, nor is the haze affected by heat or chemicals unless albumin is present. The centrifuge affects the cloudiness but little, and throws down only the merest trace of a deposit. A microbic sediment may be obtained by adding equal parts of absolute alcohol to the urine and then centrifuging (Hallé).

Examination under the microscope of a drop of urine obtained from the bottom of a centrifuge tube reveals innumerable bacteria, usually the bacillus coli, intermingled with a few epithelia and leucocytes, with perhaps casts and blood cells and crystals.

The urine may be albuminous. It is rarely phosphatic.

Course of the Disease.—The urinary signs just described are the only essential characteristics of bacteriuria. In many cases there are no subjective symptoms whatever. The symptoms, when there are any, are those of the underlying prostatitis, pyelo-nephritis, etc. Thus bacteriuria may appear under many different forms. It may be the initial or the terminal stage of pyelitis, cystitis, or urethritis. It may be the most striking symptom of prostatitis or vesiculitis. It may result from typhoidal or other infection. Yet amid these and other clinical types there are two forms of bacteriuria so prominent clinically as to overshadow all other types of the disease. These are the pyelo-nephritic type and the prostatic type.

Pyelo-nephritic Type.—See above.

Prostatic Type.—There may or may not be prostatic hypertrophy. The bacteriuria oftenest appears during a chronic gonorrhea. The urine is not albuminous unless it contains blood. It may be acid, containing bacillus coli, or alkaline, containing staphylococci or streptococci. The symptoms are those of prostatitis or vesiculitis, and the bacterium is found in the expressed secretions of the prostate and vesicles. In fact, the course of the disease is that of a prostatitis or a vesiculitis, modified only by the fact that the bacteriuria is for a longer or shorter time the prominent symptom.

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[1] *Brit. Med. Jour.*, 1881, ii, 623.
[2] *Guyon's Annales*, 1894, xii, 196.
[3] *Ibid.*, 1897, xv, 910.
[4] *Gaz. des hôp.*, 1899, lxxii, 653.
[5] *Guyon's Annales*, 1900, xviii, 148.

Diagnosis.—Bacteriuria may be suspected by the urinary appearance and odor. It can be diagnosed only by the centrifuge (which fails to clear the urine) and the microscope (which shows what little deposit there is to be almost entirely bacterial).

The distinction between pyelo-nephritic and prostatic bacteriuria may not be easy in a given case. Indeed, the two may doubtless coexist. Yet an alkaline bacteriuria is almost invariably prostatic, a bacteriuria following gonorrhea or due to instrumentation or to stricture is probably prostatic. A bacteriuria occurring during the course of a prostatitis or of a prostatic hypertrophy is doubtless prostatic. Finally, the expressed prostatic secretion (after urethral and vesical irrigation) will be found to contain the incriminated bacteria in great numbers if the bacteriuria is prostatic.

On the other hand, if the bacteriuria is pyelo-nephritic, the urine is acid and contains albumin. The clinical history may lead to a diagnosis or ureter catheterism may be required.

SUPPURATIVE PYELO-NEPHRITIS

Suppurative pyelo-nephritis is caused by stone, tubercle, injury, or infection of the kidney, or by ascending infection from the bladder. Suppuration from the first four causes is usually confined at first to one kidney, but ascending infection attacks the two kidneys simultaneously.

Ascending suppurative pyelo-nephritis has been termed *the surgical kidney,* and such it is in every sense. It is a surgical disease; it demands surgical treatment; it is caused, often enough, by the careless surgical treatment of retention cystitis. The *lesions* of surgical kidney are commonly bilateral, but the suppuration is almost always more severe in one kidney than in the other.

The course of the disease may be acute or chronic.

Acute Cases.—The symptoms of *acute suppurative pyelo-nephritis* are urinary septicemia, pyuria, and local evidences of abscess. The infection of the kidney is announced by a chill, perhaps by a succession of chills. The temperature rises abruptly and runs a septic course, or remains high. At this time there may be no urinary evidences of the renal infection, for the pus may be pent up in the kidney or its pelvis. But there is pain and tenderness to pressure over the kidney—a tenderness best elicited by Guyon's ballottement, though bimanual examination reveals little or no enlargement of the organ. The patient may succumb to the infection or pass into what might be termed the second stage of the disease. The abscess bursts. Exceptionally it bursts into the perirenal tissue and gives only temporary relief; habitually it bursts or overflows into the pelvis of the kidney and down the ureter. The aspect of the case is immediately altered. The urine is loaded with renal pus;

THE DRY, SCARLET TONGUE OF URINARY SEPTICEMIA.

The tongue is parched, scarlet, narrow, and pointed. It is often covered with a thick coat, and may be cracked, as shown in the plate.

pain, tenderness, and tumor disappear from the loin, or at least perceptibly diminish, and the septicemia abates. If the patient rallies, his condition greatly improves and the inflammation becomes catarrhal, or the abscess refills and the suppuration becomes chronic.

Chronic Cases.—The symptoms of *chronic suppurative pyelo-nephritis* are general, local, and urinary. There is urinary septicemia, renal pyuria, intermittent or continuous, pain, tenderness, and tumor of the affected organ.

The symptoms often run a remittent course. While the pus is draining well the fever is low, the local signs obscure, the urine full of pus. As the abscess fills up the general and local symptoms become more marked, while the pus disappears from the urine. So definite may be this association of symptoms that the patient himself learns that when his urine is foul and muddy he feels far better than when it is comparatively clear.

In other cases the course of the disease is more steady. The collection of pus in the kidney drains badly. There is little variation in the general, local, and urinary symptoms. Such cases may pursue one of several courses.

1. *The symptoms are all referable to the bladder.* Perhaps a severe cystitis obscures the symptoms of pyelo-nephritis; but more often it is the symptoms of the pyelo-nephritis itself that are referred to the bladder. It is a singular fact that suppuration in the kidney—and this is especially true of calculous pyelo-nephritis—may cause the most torturing tenesmus in the bladder without any pain in the loin. The association of pyuria and dysuria encourages the surgeon in his treatment of the bladder, while he neglects a suppurating kidney that may fill the whole loin. The records of innumerable futile cystotomies attest this fact, and the only way to avoid such a mistake is by a careful examination. Renal pus will be found in quantity, or else there will be a suggestive bacteriuria and albuminuria. Following up this suggestion, the surgeon will obtain unmistakable confirmatory evidence from the tongue, the temperature, examination of the loin, and cystoscopy.

2. In other cases the *local symptoms in the loin* attract the patient's notice. The *tumor* may not be so large as to compel his attention, but the *pain* may be marked. It varies from a slight soreness and tenderness to the excruciating agony of renal colic. These painful types of the disease commonly occur in calculous cases.

3. *Dyspeptic and septic cases,* in which the symptoms of urinary septicemia predominate, are often obscure, especially if the kidney is not notably enlarged or tender. Yet here again a careful examination discloses evidences of renal inflammation.

4. In many instances there is for years nothing more than a *symp-*

lomless pyuria, which may be interrupted from time to time by outbreaks of acute pyelo-nephritis or of focal suppurative nephritis.

Termination.—The inflammation runs one or other of the above courses for weeks, months, or years before it terminates. It may end in resolution. The foci of renal suppuration are effectively drained, and there is no further accumulation of pus. In the process of cure the inflammation passes through a catarrhal stage that may be prolonged indefinitely. The kidney does not recover from its sclerosis, but its remaining parenchyma cells hypertrophy.

If the patient does not recover and the inflammation remains mild, the vital forces weaken and nocturnal polyuria occurs. The heart undergoes compensatory hypertrophy, and general arteriosclerosis is likely to ensue. The digestion is not good. Constipation is the rule. Edema does not often appear. In short, there is renal insufficiency and the patient suffers from urinary toxemia. While he would not style himself actually ill, he is obviously not well. He has an unhealthy look, an impaired digestion, a poor circulation, and damaged kidneys. He may still be able to endure hard work and severe mental strain, but sooner or later he is smitten down. A slight cold brings on pneumonia, edema of the lungs, or acute congestion of the kidneys, with suppression of urine; an excessive exertion or emotion induces apoplexy. Or his eyesight fails, and the ophthalmoscope reveals the origin of his troubles, or a chance examination for life insurance discloses the urinary conditions. Such is one side of the picture—what might be termed its medical aspect. It is that of chronic interstitial nephritis from whatever cause.

On the other hand, the patient may die of sepsis or of suppression of urine. The fatal event may be hastened by extension of the inflammation to the perinephritic tissue, or by pyonephrosis from ureteral or urethral obstruction.

Diagnosis.—The most important suggestions as to diagnosis have been made in the preceding chapter. Whether the symptoms assume a vesical, dyspeptic, or septic type, the urine and the ureter catheter afford ample evidence of the involvement of the kidney. But, given a suppuration in the kidney, it may be extremely difficult to distinguish between the simple, the calculous, and the tubercular forms of suppurative pyelonephritis.

The differential diagnosis of these special forms of pyelo-nephritis is treated in detail elsewhere. Every pyelo-nephritic should be skiagraphed and examined for tuberculosis.

PYONEPHROSIS

Pyonephrosis is not a primary condition. It may develop from suppurative pyelo-nephritis (whether simple, calculous, or tubercular), by

occlusion of the ureter, or from hydronephrosis by infection of the contents of the sac. Like hydronephrosis, pyonephrosis may be fixed or intermittent. It is usually the former; yet, however intermittent the pyonephrosis, it does not (with the rarest exceptions) empty itself completely.

The symptoms of pyonephrosis may best be expressed by comparison with those of pyelo-nephritis. They are more severe in almost every respect. The symptoms of pyonephrosis are habitually constant, not remittent. There is grave chronic urinary septicemia with considerable fever. The pains, vesical or renal, like those of pyelo-nephritis, may be of any intensity.

There may be an enormous tumor in the loin or the kidney may be quite impalpable. It is almost always sensitive.

The urine is full of renal pus unless the pyonephrosis is (temporarily or permanently) completely closed. In this event the urine remains slightly purulent, the pus coming from the ureter and from the opposite kidney, which is almost invariably infected.

The striking features of pyonephrosis are the lumbar tenderness and the septic condition of the patient. The lumbar tumor may or may not be palpable. The urinary septicemia is always marked.

The outcome of the disease is death by sepsis or suppression, or rupture into the ureter, into a neighboring viscus, or into the perinephritic fat. Exceptionally the contents of a pyonephrotic sac undergo a sort of caseation and become aseptic.

Diagnosis.—Pyonephrosis is diagnosed from hydronephrosis by the presence of urinary pus. It is not always possible, nor is it necessary, to distinguish between a small pyonephrosis and a pyelo-nephritis. They can only be distinguished, short of operation, by the renal injection tests employed in hydronephrosis.

FOCAL SUPPURATIVE NEPHRITIS

Animal experimentation has encouraged a mistaken point of view in relation to focal suppurative nephritis. It is quite true, as illustrated by the experiments of Albarran, Brewer, and others, that if a kidney is damaged by contusion or by ligation of its ureter, intravenous injection of pyogenic bacteria results in acute bacterial nephritis of the damaged organ with tendency to miliary suppuration, while its undamaged fellow escapes. It is equally true that one occasionally sees a case of focal suppurative nephritis directly resulting from furunculosis, one of the exanthemata of some other distant infectious process. Yet focal suppurative nephritis is almost always attributable to a preëxisting local lesion. In other words, the normal kidney is quite as competent as is any other organ to dispose of the bacteria and toxins delivered to it by

the circulation. Its failure to do this depends rather upon local causes, e. g., stone, retention, or preëxistent pyelo-nephritis, than upon the general infection. For this reason focal suppurative nephritis is almost inevitably unilateral.

The title, Septic Infarcts of the Kidney, is inappropriate to this disease for the above reason and also because the miliary foci of the suppuration are not, properly speaking, infarcts, but rather the expression of a multilocular destruction of kidney tissue by hyperacute bacterial inflammation. Indeed, it would be both permissible and illuminating to divide acute renal infections into the following types, viz.:

1. Acute pyelitis (catarrhal pyelo-nephritis), in which the infection is mild and expends itself chiefly upon the renal pelvis.

2. Acute pyelo-nephritis, in which kidney and pelvis alike are more sharply inflamed, but in which there is no marked accumulation of bacteria in the kidney, no tendency to focal suppuration.

3. Focal suppurative nephritis, in which the kidney is overwhelmed by the infection, its tissue breaking down into miliary abscesses as evidence of its inability to combat the intense inoculation.

Clinical Picture.—The inflammation begins with a chill and proceeds with intense septic fever. The local pain may be so slight as to be overlooked, or so intense as to suggest acute cholecystitis, stomach ulcer, etc. *The urine may be entirely free from pus and bacteria,* though it is almost always purulent, sometimes bloody.

The sepsis is often hyperacute, carrying off the patient in from three to fourteen days.

Diagnosis.—Intense sepsis is always the prominent symptom. If the urine is clear the infection is almost invariably misinterpreted. If the pain is intense, it is usually referred to the hypochondriac or epigastric region and attributed to gastric or duodenal ulcer, acute cholecystitis, acute pancreatitis, or acute hepatitis. But the diagnosis is readily made by renal ballottement, which always elicits costo-vertebral tenderness; urinalysis, which almost invariably discloses pus, and ureter catheterism, which establishes the deficiency of one kidney and the integrity of the other.

RENAL INFECTIONS IN CHILDHOOD

Of late years attention has been called to the spontaneous urinary infections of infancy and childhood.[1] The colon bacillus is the usual

[1] Thompson, *Scot. Med. and Surg. Jour.*, July, 1902; Mellin, *Jour. d. Kinderheilk.*, 1903, No. 1; Hartwig, *Berl. klin. Wochenschr.*, November 30, 1903; Zahorski, *St. Louis Courier of Med.*, February, 1907; Valagusse, *Il Polyclinico*, March, 1907; Langstein, *Therap. Monatsh.*, May, 1907; Fischer, *Archives of Pediat.*, June, 1907; Box, *Lancet*, January, 1908.

cause. Local causes, such as retention, stone, and tumor, are rare. The infection is much more common in girls than in boys, and the bacteria, apparently, in many instances, reach the urinary organs by way of the urethra. Children under five years of age seem more vulnerable than those beyond this age. The lesion is sometimes spoken of as a cystitis, but pyelo-nephritis is surely commoner.

The clinical types are two—the urinary and the septic.

The urinary type is a bacteriuria or pyuria with subjective symptoms few or absent. The septic type runs an active course. Pyelonephritis and malaria are said to be the only obscure maladies likely to cause repeated chills in infants.

Digestive symptoms, such as diarrhea and vomiting, are common. Incontinence of urine is not rare and has been suggested as one of the etiological factors. Painful urination and renal colic occur.

Examination of the urine establishes the diagnosis. If there is fever the affected kidney is sensitive to pressure.

RENAL INFECTIONS IN PREGNANCY

Pressure of the gravid uterus upon the ureter causes renal retention and renders the pregnant woman peculiarly liable to renal infection. The inflammation is usually unilateral, the right kidney the one affected. Swift [1] has collected 41 cases, of which 31 were in the right kidney. Albeck [2] has collected 52 cases (14 per cent of 392 patients examined) appearing between the fifth and the tenth month in increasing frequency (2 cases in the fifth, then 4, 9, 8, 11, and 18). The colon bacillus predominates (76 out of 92 cases).

If afebrile, the albuminuria is noted, the bacilluria or pyuria overlooked, and the case mistaken for puerperal nephritis. If febrile, it may be mistaken for typhoid, or if postpartum, for sepsis. But often there is considerable pain in the side, which may lead to the diagnosis of salpingitis or appendicitis.

The readiest formula of diagnosis is that suggested by Cragin: if there is albuminuria or fever after the third month of pregnancy, examine the urine obtained by catheter for pus and bacteria.

The literature has been reviewed by Rupanner.[3]

PROGNOSIS OF RENAL INFECTION

As to prognosis, the various surgical inflammations of the kidney have been dealt with separately. Dealing with them collectively, we may

[1] *Boston Med. and Surg. Jour.*, February 21, 1907.
[2] *Zeitschr. f. Geb. u. Gyn.*, 1907, No. 3.
[3] *Münch. med. Wochenschr.*, January 30, 1906.

say that the prognosis depends upon the damage done to the kidney tissue (*a*) by the bacterial inflammation, and (*b*) by the interstitial nephritis. When an acute catarrhal pyelo-nephritis is cured, the casts and albumin disappear from the urine after a few months, and no sign of the inflammation remains. With chronic catarrhal pyelo-nephritis the case is different. While this inflammation does not directly threaten life, and while the bacteria may usually be driven from the kidney by a prolonged course of suitable treatment, the interstitial sclerosis remains, and the kidneys never return to a normal state. Whether this sclerosis continues stationary after its bacterial cause has been eliminated, or whether it progresses slowly after the fashion of the medical chronic interstitial nephritis, I cannot say.

When there is actual suppuration in the kidney substance, whether the condition be a suppurating pyelo-nephritis, a pyonephrosis, or an abscess of the kidney substance, the prospect is still less encouraging. The patient often escapes with his life, and the suppuration may be controlled by appropriate measures, but in many instances the resultant catarrhal pyelo-nephritis cannot be entirely conquered; and even if it is, the kidney is always left badly scarred. But one of the most striking features of renal pathology is compensatory hypertrophy of the kidney. Not only will one kidney do the work of two after nephrectomy, but the merest shell of a kidney, the dense fibrous sac of a pyonephrosis in which the naked eye detects no secreting structure whatever, is still a functionating organ. Its power of excreting solids may be much diminished, but its capacity for transmitting water is practically unimpaired.

Whether such an organ is worth preserving depends upon the integrity of its fellow.

CHAPTER XXXV

TREATMENT OF RENAL INFECTIONS

Under this title we may consider:

- Prophylaxis.
- Treatment of Infection without Retention or Sepsis
  - by Medication.
  - by Pelvic Lavage.
  - by Operation.
- Treatment of Infection Complicating Retention.
- Treatment of Infection with Sepsis.
  - Urethral Chill.
  - Urinary Septicemia.
  - Pyelo-nephritis.
  - Pyonephrosis.
  - Focal Suppurative Nephritis.

PROPHYLAXIS

All *ascending infection* of the kidney may be prevented by prompt and efficient treatment of the cause of retention, be it stricture, prostate, or what not. *Descending infections* do not so readily lend themselves to prophylaxis; yet it is often possible to nip acute puerperal or typhoid pyelo-nephritis in the bud, if the possibility of this renal infection is borne in mind. The operative prevention of calculous pyelo-nephritis does not concern us here.

The condition of the bowels is of the utmost importance in the prevention of infection of the kidneys. The bacillus coli is the infective agent in almost every case of descending renal infection. This bacillus reaches the general circulation from the intestine only when the bowels are constipated or otherwise diseased, and is excreted from the general circulation through the kidneys. Hence, as long as the regular daily movements of the bowels are uninterrupted there appears to be little danger of spontaneous infection. It is intestinal stagnation that applies the spark.

Hence, renal inflammations are preventable in two ways: The re-

tention that prepares the kidney for infection and the intestinal stagnation that supplies the infectious agent may both be prevented.

During typhoid, hexamethylenamin may be administered as a prophylactic of biliary calculi as well as of urinary infection. Its administration during scarlatina has been advised in order to minimize the prospect of subsequent nephritis.

TREATMENT OF UNCOMPLICATED INFECTION

The treatment of pyelitis or pyelo-nephritis not due to stone, tubercle, or retention, and not complicated by sepsis, is conducted in the following manner:

Medication.—Administration of hexamethylenamin, or, if this irritates, of one of its substitutes, is begun at a low dose and gradually increased in the manner already described (p. 343). At the same time the patient is encouraged to drink all the water he can, up to the point of urinating about eight times a day. The progress of the case is noted by the aid of centrifuge and microscope.

Under such a course mild infections due to pyogenic cocci are likely to subside rapidly; but coli infections are much more obstinate. In any case the pus in the urine is likely to be reduced to a mere haze.

If this treatment clears the urine it should be continued several weeks thereafter. If it fails, the patient has the choice of continuing the urinary antiseptic, submitting to renal lavage, or doing nothing. The first alternative should be chosen if there is any tendency to acute outbreaks of inflammation, until this is controlled.

Pelvic Lavage.—The question whether or not to irrigate the renal pelvis arises when general medication has failed. Unfortunately, the very cases that do best under lavage are the very ones that are most amenable to general medication. Chronic and severe cases, and especially coli infections, are rebellious to local as well as to general antisepsis. Yet in selected cases, when the necessary instrumentation is well borne, it is proper to irrigate the renal pelvis.[1]

The technic of the operation is the following: The ureter is catheterized, the catheter, if possible, introduced into the pelvis. The pelvis is then slowly filled with an antiseptic solution, and this is permitted to escape through the ureter catheter, which is then withdrawn. The injection is made by means of a 10-c.c. hypodermic syringe (antitoxin syringe) to which is attached a needle that fits snugly into the ureter catheter.

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[1] Recent contributions to this study are: Ayres, *Internat. Jour. of Surgery*, May, 1909; Kelly, *Med. Record*, April 8, 1905; Eaton, *Calif. State Jour. of Medicine*, March, 1907; Garceau, *Jour. of the Amer. Med. Assoc.*, January 23, 1909.

The solutions commonly employed are silver nitrate (1 : 1,000 up to 1 : 200), protargol (1 : 500 up to 2 per cent), and argyrol (up to saturation). Injections are repeated once or twice a week.

Operation.—If general medication and pelvic lavage both fail, the patient must be content to put up with his renal infection, unless he is willing to attempt operative relief.

To do nothing is usually preferable. The patient with catarrhal pyelo-nephritis, or with a controlled suppurative process, may live quite indefinitely. I know one patient who has lived in this condition for fifty years, another more than forty years, another twenty, and many others for shorter periods.

Operation, on the other hand, offers a somewhat uncertain prospect. Exploratory nephrotomy upon a pyelo-nephritic kidney, supposedly calculous, has often failed to relieve the stone, but succeeded in relieving the pyelo-nephritis. This end is accomplished (often unwittingly) either by relieving retention due to slight adhesions about the renal pelvis or by relieving kidney tension. If operation is undertaken, therefore, it should be with the deliberate intention of freeing the renal pelvis, decapsulating the kidney, and, if necessary, performing nephropexy. Nephrotomy should not be performed unless required in the search for stone.

But this operation affords no satisfactory promise of cure, and should be undertaken only under exceptional circumstances.

The Effect of Decapsulation upon the Kidney.—The disappearance of albuminuria after an operation performed for surgical disease of the kidney has been noted by various authors, and is not a very uncommon experience. I have encountered several such cases in which the operations of nephro-lithotomy, nephropexy, and nephrotomy for suppurative pyelo-nephritis have resulted not only in the cure of the surgical condition, but also in the apparent *restitutio ad integrum* of the affected organ. In 1901 Dr. Edebohls,[1] having observed these facts in a number of nephropexies, conceived the idea of aiding the return to normal of the kidney by stripping from it its fibrous capsule, on the theory that tension would thus be relieved and that the new capsule formed from the cellular tissue about the kidney might prove more vascular than the old, and thus supply more blood to the kidney.

Following out this theory, at first chiefly upon cases of albuminuria due to nephroptosis, later upon all kinds of albuminurics, Edebohls[2] reported, in 1903, 51 cases, of which 14 per cent died, 44 per cent improved, and 14 per cent were definitely cured. But, in the meanwhile, Rovsing,[3] by a series of careful investigations, demonstrated that bac-

[1] *Med. Record*, 1901, lx, 690. [2] *Ibid.*, 1903, lxiii, 481.
[3] "Mitteil. aus d. Grenzgebiet. d. Med. u. Chir.," 1902, x, 288.

terial nephritis (i. e., catarrhal pyelo-nephritis), or nephritis causing renal pain or hematuria, could be cured by nephrotomy with decapsulation, but that true Bright's disease, nonsurgical nephritis, could not be so cured.

Experiments upon dogs, rabbits, and cats have shown that the capsule of scar tissue formed after decapsulation, although more vascular at first, soon develops into a fibrous layer closely resembling the original capsule, and is, if anything, more closely adherent to the kidney. Autopsy reports are few and conflicting, but in the main confirm this view. At present the clinical findings, which have accumulated to a considerable number, form a safer guide. Suker [1] investigated 19 decapsulations for chronic interstitial (17) and diffuse (2) nephritis with ocular complications. Of these (excluding 2 cases) 6 died in a few days, 10 more died within the year (94 per cent total mortality), and 1 is alive, "improved," at the end of a year. Elliott [2] collected 112 reported decapsulations, among which 29 cases of nephroptosis, with albuminuria, operated upon by nephropexy with or without decapsulation, almost all did well. His 79 cases of medical nephritis show 36 deaths, 14 unimproved, 26 improved. Unfortunately, most of the cases were last reported within six months after operation. Improvement for this brief space is doubtless due to the relief of congestion. Indeed, the benefit derived from decapsulation is apparently due solely to this relief of congestion, not to any permanent change in the blood supply.

Edebohls [3] has operated upon 102 cases and observed the survivors for at least fifteen months. Of these, 11 died as a result of operation, 29 more of chronic nephritis, and 10 more from other causes. Of the 53 survivors, Edebohls estimates 11 as improved, 33 as cured. Edebohls's definition of a cure is the absence of symptoms of nephritis and the production of entirely normal urine for six months. That only 18 of these patients were "cured" within a year of the time of operation probably shows, contrary to Edebohls's opinion, how independent of operation these so-called cures are.

It is the consensus of opinion that decapsulation may be beneficial to the acutely congested kidney, whether the congestion be bacterial or toxic, but that it is of no service in chronic nephritis.

TREATMENT OF INFECTION COMPLICATING RETENTION

The treatment of infected hydronephrosis is detailed in the chapter on Hydronephrosis, that of pyonephrosis below.

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[1] *Jour. of the Amer. Med. Assoc.*, 1904, xlii, 580.
[2] *N. Y. Med. Jour.*, 1904, lxxix, 1078.
[3] *Jour. of the Amer. Med. Assoc.*, 1909, lii, 195.

TREATMENT OF URINARY SEPTICEMIA

Urethral Chill.—The best treatment for urethral chill is prophylaxis. The five essentials of prophylaxis are:

1. Gentleness in manipulation.
2. Irrigation of the urethra and bladder at the end of every important urethral operation.
3. Efficient drainage—according to the nature of the case.
4. Urinary antisepsis and dilution, and
5. Stimulation of the kidneys and other emunctories.

Antisepsis and irrigation are achieved by local washings and, at the same time, by rendering the natural irrigating fluid—the urine—as unirritating, as plentiful, and as antiseptic as possible. Copious draughts of diuretic mineral waters, and the administration of hexamethylenamin (0.5 to 1.5 grams *t. i. d.*), or salol (2 to 3 grams a day in divided doses), fulfill this latter indication, while drainage is established according to the requirements of the case. The final requisite is fulfilled by the diuretic mineral waters and hexamethylenamin (a valuable renal stimulant), together with a warm bath and a cathartic before any operation upon the urinary tract.

Practically speaking, therefore, the patient must be prepared for every formal operation upon his urinary organs by a course of two days' administration of hexamethylenamin (0.5 gram *t. i. d.*) and a diuretic water, a warm bath, and a cathartic, and, if there is cystitis, some attempt must be made by daily irrigations of the bladder to render his urine as sweet as possible; while, if the patient threatens to become septic or uremic, the same course of treatment is to be instituted, and drainage established, if necessary, through the loin, the perineum, or the retained catheter. Quiet and rest in bed are beneficial. Anesthesia has no effect on urethral chill, except in so far as ether is a tax on damaged kidneys, and cocain more toxic in the deep urethra than elsewhere.

For urethral chill, when it has once set in, rest in bed, a hot foot-bath, fluid diet, and urinary dilution and antisepsis usually suffice; but if the attack is a rapidly pernicious one, morphin, hot-air baths, the hot pack, stimulants, and cups to the loins constitute the treatment. The sodio-salicylate of theobromin seems to be of service only in chronic cases. The benefit of venesection and infusion in uremia must not be lost sight of.

Urinary Septicemia.—The treatment of urinary septicemia, in whatever form, is conducted along the same general lines. Retention and suppuration are to be relieved by drainage (catheterization, urethrotomy, cystotomy, or nephrotomy), irrigation, and the administration of urinary antiseptics, while the patient's vitality is reënforced by rest in

bed and stimulants, his toxemia combated by diuresis, catharsis, and diaphoresis, and his symptoms appropriately relieved. Hexamethylenamin (or salol), diuretic waters, saline infusion, saline cathartics, nitroglycerin, and strychnin form the basis of treatment, while drainage is afforded according to the requirements of the case.

It is impossible to particularize beyond this. The methods by which drainage should be obtained are discussed under the various appropriate sections. This much may be said, however, that, while the existence of urinary septicemia is evidence of retention and absorption of bacterial toxins through the kidneys, the retention to which the infection is attributable often occurs in the urethra or prostate, and hence, to relieve renal retention and suppuration in such cases, it is the bladder, and not the kidney, that must be drained.

Suppurative Pyelo-nephritis Causing Sepsis.—The inflamed kidney may be considered an abscess cavity. What it requires is drainage and irrigation with an antiseptic fluid.

Suppurative pyelo-nephritis (not calculous or tubercular) may sometimes be relieved by the same indirect method of drainage that applies to catarrhal inflammations. Thus a surgical kidney due to cystitis from prostatic retention may usually be cured by draining the bladder. In such cases the restored equilibrium of urinary pressure permits the pus to drain freely. But often enough vesical drainage does not suffice. The pelvis is so pouched or the renal substance so inflamed that the kidney itself must be drained by nephrotomy.

The proper treatment of ascending pyelo-nephritis is therefore first relief of the cause of infection; second, urinary antisepsis and diuresis; third (if necessary), nephrotomy. If nephrotomy fails to relieve the sepsis, secondary nephrectomy must be performed.

If the pyelo-nephritis is descending the treatment is the same, less the treatment of the lower urinary tract.

Pyonephrosis.—Whether the pyonephrosis be intermittent or constant, the pyonephrotic kidney must be regarded as an abscess requiring drainage. This drainage may sometimes be provided by relief of ureteral or urethral obstruction, exceptionally by ureter catheterism. But, as a rule, the patient comes to the surgeon in an acute septic condition, requiring immediate direct surgical attack upon the kidney.

Before operation every effort should be made by means of functional renal diagnosis to establish the presence and functional capacity of the opposite kidney. If this opposite kidney is functionally competent the pyonephrosis may be attacked either by nephrotomy or by nephrectomy; if not, only nephrotomy may be contemplated.

One hears much discussion on the comparative merits of *nephrotomy and nephrectomy* in the treatment of suppurating kidney. Inasmuch as

the question can never be decided one way or the other for all cases, the discussion will doubtless continue. But the essence of the matter is this: if adequate ureteral drainage can be established nephrotomy suffices. Nephrectomy is required when the kidney is so pouched that the urine and pus cannot be made to drain efficiently through the ureter, or when its suppuration will do the patient more harm than its secretion will do him good.

Nephrectomy may be primary or secondary. There are advantages on each side. For secondary nephrectomy it is claimed that it exposes the patient to a severe shock—which nephrectomy always does—only when he has been given the opportunity to rally from his septicemia by a palliative nephrotomy. On the other hand, it is urged that secondary nephrectomy, on account of the adhesions formed after nephrotomy, is far more difficult and dangerous than primary nephrectomy. Both contentions are just, and, in order to reconcile the opposing views, it has been suggested that secondary nephrectomy be performed after the patient has somewhat recovered from his sepsis, but before dense adhesions can form. So long as any mortality remains to either operation, there will be a difference of opinion in this matter. But it is generally conceded that—

1. If the patient is gravely septic or uremic, it is safest to perform rapid nephrectomy.

2. If the general condition is good, every effort should be made to reëstablish ureteral drainage, and the kidney should be removed only (*a*) when it is obvious that ureteral drainage can never be reëstablished, or (*b*) when the suppurating cavity is so large and the remaining renal tissue so slight that it does not appear possible for the cavity to close down without subjecting the patient to a prolonged course of suppuration, for which the possession of an extremely disabled kidney would never compensate.

3. If, for any reason, ureteral drainage is doubtful, the patient should be given the benefit of this doubt, and nephrectomy postponed until the persistent lumbar sinus has shown that the reëstablishment of ureteral drainage is not to be expected.

4. Nephrectomy, primary or secondary, should not be thought of until it is proved that the opposite kidney is capable of supporting life.

Such are the general rules that must guide the surgeon.

Focal Suppurative Nephritis.—Since Brewer [1] has shown that focal suppurative nephritis is almost always unilateral at first, and since his experience has been supported by that of other surgeons to the effect that the multiple septic foci can rarely be drained successfully by nephrotomy, the treatment of this condition manifestly consists in estab-

[1] "Surgery, Gyn., and Obstet.," 1906, ii, 485.

lishing the competence of the opposite kidney and prompt primary nephrectomy.

One should not be misled by the occasional reports of successful partial nephrectomy or nephrotomy for this condition. Only the expert can afford to make any exceptions to this rule calling for immediate nephrectomy as the treatment of focal suppurative nephritis.

CHAPTER XXXVI

PERINEPHRITIC EXTRAVASATIONS AND INFLAMMATIONS—RENAL FISTULA

EXTRAVASATION

The extravasation of feces from the intestine or of air from the lung or bowel into the perirenal tissues is an unimportant phenomenon sometimes associated with grave visceral lesions.

Effusions of urine and blood are more frequent, and, since the source of the blood is usually the kidney, they often occur together.

The extravasation consists of blood alone if it results from an injury to the renal artery or to the renal parenchyma without affecting the pelvis or the ureter. (Bilateral retroperitoneal hematoma may also result from rupture of an aortic aneurysm.) If both the kidney and its pelvis are torn a *urohematoma* results, the blood preponderating at first (unless the kidney is hydronephrotic), the urine later; or rather, a lumbar tumor appearing immediately after an injury to the loin and rapidly increasing in size during the first twenty-four hours is a hematoma; while urinary extravasation (unless preceded by hematoma) produces a slowly growing tumor, which may not be noticed until some weeks after the infliction of the injury. Occasionally the lesion in the pelvis or ureter is so small, and the escape of urine so gradual, that the cellular tissue forms a tense sac about the fluid. The name *traumatic hydronephrosis* has been given to this condition, in spite of the fact that there is no true dilatation of the renal pelvis. True traumatic hydronephrosis results from cicatricial stricture of an injured ureter, and is excessively rare. Sollers (Rattier [1]) and Pye Smith (Morris) have reported authentic cases. In Mannasse's case (Rattier, Obs. XXIV) a pseudo-hydronephrosis appeared eighteen months after injury.

Course.—The effusion spreads as long as hemorrhage or urinary leakage continues. As the perineal fascia is usually uninjured, the extravasation forms an elastic swelling filling the loin. Thence it may extend downward to the inguinal region, the pelvis, and thigh; but this is exceptional.

If the extravasation is hemorrhagic, it is likely to remain aseptic and

[1] "Des épanchements urineux d'origine rénale," Paris, 1899, p. 17

to become a blood cyst, with grumous or serous contents, if it is too large to be absorbed. But when the tumor is a urohematoma, as is usually the case, the danger of infection is great, not so much from the urine itself—since this fluid is probably aseptic—but by the bacteria habitually passed through the urinary channels without finding any lodgment, but which find ideal conditions for their proliferation in so excellent a culture medium as is formed by the mixed blood and urine. Suppuration with secondary perinephritic abscess is the usual outcome.

Treatment.—The proper treatment of perinephritic extravasation, be it hematoma or urohematoma, is incision, exploration, and drainage, for the purpose of (*a*) preventing suppuration, (*b*) suturing large rents in the kidney or its pelvis, and (*c*) removing any ureteral kink, valve, obstruction, or stricture in order to reëstablish the urinary flow through the natural passages. Therefore it is especially important to investigate the condition of the pelvis and ureter.

PERINEPHRITIS AND PERINEPHRITIC ABSCESS

Perinephritis is an inflammation of the fatty fibrous envelope of the kidney. It is encountered under three forms: (1) Suppurating peri-

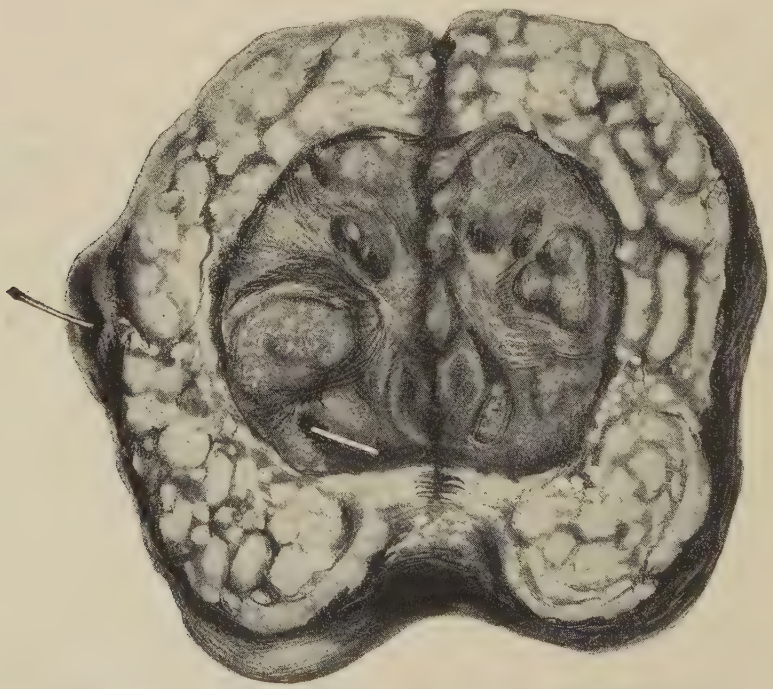

Fig. 75.—Perinephritis (Morris.) Dense fibro-lipomatous perinephritis due to intrarenal suppuration. The probe shows a fistula, through which the suppuration has extended to the perirenal tissue in spite of the protective inflammation.

nephritis, (2) fibro-lipomatous perinephritis, and (3) sclerotic perinephritis. The two latter varieties may be dismissed with a word.

Fibro-lipomatous and Sclerotic Perinephritis

Each of these allied processes is a protective inflammation of the perirenal fat secondary to suppurative inflammation of the kidney itself. When the fatty capsule is found contracted and condensed, as it were, into a solid mass of firm fat bound to the kidney by dense bands of fibrous tissue, the inflammation is termed fibro-lipomatous; when the fat is entirely replaced by fibrous tissue the term sclerotic is used. In each instance the reaction in the perinephritic tissue is a chronic fibrosis aroused by long-continued suppuration within the kidney. If the renal inflammation is chiefly confined to the pelvis, the perirenal reaction manifests itself by the accumulation of dense masses of fat and fibrous tissue about that part of the organ. If there is a considerable inflammation of the renal parenchyma, the whole kidney is enveloped in the fibro-lipomatous mass, which may be sufficiently thick to produce a considerable tumor (Fig. 75).

Suppurating Perinephritis—Perinephritic Abscess

Perinephritic abscess may be primary or secondary, simple or tubercular.

Etiology.—The causes of perirenal abscess may be tabulated as follows:

Primary Abscess—
- Traumatic—
  - Infection from the kidney.
  - Infection from the wound.
- Spontaneous—
  - Attributed to a sprain, a chill, or to general debility.

Secondary Abscess—
- Of renal origin—
  - Calculous or tubercular pyelo-nephritis.
  - Pyonephrosis.
  - Suppurative nephritis.
- From other viscera—
  - Appendix.
  - Liver.
  - Gall-bladder.
  - Pelvic organs.
  - Vertebræ (often tubercular).

I have encountered traumatic abscess, abscess due to calculous and to tubercular pyelo-nephritis, abscess arising from an acute appendicitis, abscess secondary to cystotomy, and spontaneous tubercular abscess without evident connection with any bone or viscus.

Symptoms.—The *onset* of suppuration is usually insidious, marked by irregular fever (rarely by a chill), tenderness over the kidney, a stiffness and tendency to favor the affected side in walking or sitting, and restricted extension of the thigh, without obstruction to flexion. Townsend [1] has indicated the possibility of mistaking beginning perinephritis for hip disease. Even when perinephritis succeeds injury the history may be so obscure as to be misleading. A careful physical examination, however, will show that the seat of inflammation is the loin, and not the spine or hip.

The *course* of the disease is that of a retroperitoneal lumbar abscess. Resolution without the formation of an abscess is rare. The irregular fever usually continues (it is often mistaken for typhoid), the pain and tenderness in the loin, the forced flexion of the thigh grow more marked, and a tumor appears in the loin.

This tumor is quite characteristic. The whole loin is perceptibly bulged outward and backward, with less protuberance in front than is the case when the tumor is intrarenal. Moreover, the tumor formed by perirenal abscess is quite immobile. When large, fluctuation can be elicited, and edema of the overlying skin may appear.

The *termination* of the disease, unless subjected to operation, is death by septicemia or by rupture. Küster records 34 cases of rupture distributed as follows:

Pleura and bronchi	18 cases.
Intestine (colon)	11 "
Peritoneum	2 "
Bladder, or bladder and vagina	3 "

Morris says: "Compared with the frequency with which perinephritic abscesses perforate the colon, the pleura, or the lung, the other forms of spontaneous opening are rare. Probably it is not an exaggeration to say that of every 12 cases which pursue their own course, 4 or 5 open into the pleural cavity or the lung." External rupture through the loin is rare.

Diagnosis.—While the diagnosis may be difficult in the early stages the presence of leukocystosis, the absence of malarial organisms from the blood, and a negative Widal reaction, will show that the fever is due to suppuration somewhere; and tenderness in the loin suggests the site

[1] *Jour. Am. Med. Assoc.*, 1904, November 26, p. 1626.

of suppuration. There are no urinary signs essentially connected with this malady.

In the later stages the tumor is pathognomonic. The one tubercular case I have seen was unmistakable, although the only subjective symptom was an inability to cross the corresponding leg over the other without lifting it with the hand. Yet a mere inspection of the flank showed the presence of the abscess, which, when incised, yielded a liter of pus.

Prognosis.—Spontaneous cure by resolution, encapsulation, or rupture is very rare, and is never to be expected.

Early operation gives good results. The longer the operation is delayed the worse the prognosis.

Treatment.—The only treatment for suppurating perinephritis is incision and drainage. Even when the case is diagnosed so early that the presence of pus is doubtful, an exploratory incision—although nothing be found—offers a better prospect of cure than any expectant treatment. Rupture of the abscess into the intestine is no contra-indication to operation; it is rather an incentive, since the abscess drains but poorly and the admixture of feces with its contents is calculated to add fuel to the inflammation.

In operating, the primary object is to secure free drainage. The usual oblique incision insures this and permits thorough exploration. As soon as the abscess is opened, and while it is being copiously irrigated with salt solution, the finger is introduced, and with it the cavity is carefully explored for the purpose of discovering whether the abscess arises from the kidney, the appendix, or some other organ. Bimanual palpation may reveal a diseased kidney; but the question as to whether, in such event, nephrotomy should be performed immediately, or delayed until the perirenal suppuration is reduced, is one that must be decided upon the merits of the case, especially in reference to the condition of the patient, the severity of the infection, the amount of intrarenal suppuration, and the condition of the opposite kidney. The possibility of associated empyema should not be forgotten. After-treatment consists in prolonged drainage.

RENAL FISTULA

Spontaneous Fistula.—Spontaneous renal fistula caused by the rupture of a perinephritic abscess is so rare in this surgical generation and postoperative fistula so common that renal fistula is actually a late complication of operations upon the kidney. Spontaneous fistula may be dismissed with a word. A pyonephrosis or a perinephritic abscess may burst through the loin into the stomach or bowel or into the pleura or lung. The occurrence of such a rupture is heralded by a sharp pain and followed by the passage of pus through the skin, from the bowel or

from the bronchi, as the case may be. It is common knowledge that a large abscess bursting thus spontaneously will drain but poorly and should be submitted to prompt incision, even though the patient's condition is considered desperate; for, however ill he may be, the prolonged suppuration will only sap his strength, and his safety lies in adequate drainage.

Postoperative Fistula.—Postoperative fistula may be expected to remain patent for several weeks. In the first days the gush of urine through the wound is often considerable. But all ordinary surgical wounds of the kidney may be expected to heal kindly unless foreign body, obstruction, disease, or a considerable loss of tissue impedes the natural process of repair.

Thus the causes of postoperative fistula may be grouped as follows:

1. Occlusion of the ureter.
2. Foreign body—e. g., stone, suture.
3. Inefficient drainage of suppurating pockets.
4. Tuberculosis or neoplasm.
5. Loss of substance of pelvis or ureter.
6. Low general vitality.
7. Lesion of the colon causing fecal fistula.

Occlusion of the ureter is probably the commonest cause of fistula after nephrotomy, and it is easily understood that so long as the ureter remains obstructed the urine will seek the right of way through the loin. In certain cases the obstruction is only comparative, the kidney being pouched and the ureter kinked. Such cases have been cured by the ureteral catheter *à demeure* (Albarran); but one cannot feel sure that a case so treated may not subsequently develop into a hydronephrosis.

The *symptoms* of fistula are the discharge of urine or of urine mingled with pus, or, if the kidney be completely disorganized, of pure pus. In this last class of cases there is often a great deal of pocketing and marked sepsis.

Treatment.—The treatment of renal fistula is surgical. The manipulative treatment by ureteral catheter is rarely applicable. The removal of foreign bodies need not be insisted upon. For example, I have known a man to carry a tube in his loin for eight years because he feared to be without it, and to heal up in three weeks after it was extracted.

Of course local treatment by antiseptic and stimulating irrigations should be employed in conjunction with appropriate tonics and hygiene for a sufficient time before operative treatment of the fistula is considered. But if, in spite of all such measures, the discharge persists, it can only be cured by operation. Before proceeding to cut down upon such a kidney the surgeon should familiarize himself with every detail of the patient's history and avail himself of every means of physical diagnosis

in order to estimate the condition of the two kidneys. If, as is usually the case, all the urine of one kidney issues through the loin, the condition of the other is readily ascertained by examining the urine drawn from the bladder.

From the data thus obtained the surgeon should decide whether to attempt nephrectomy or ligature of the renal artery.

CHAPTER XXXVII

URINARY CALCULUS: VARIETIES—ETIOLOGY—TREATMENT OTHER THAN RADICAL

A URINARY stone, or calculus, is a body resembling a stone in its general characteristics, and formed of crystalline urinary salts (exceptionally of other substances) held together by viscid organic matter, and showing, microscopically or to the naked eye, a laminated structure.

All true calculi are composed of a nucleus, single or multiple, and layers more or less concentric of the same or of another material arranged around it (Figs. 76, 77, 78). This is the case for large as well as for microscopic calculi, even for those requiring a magnifying power of 250 diameters (Beale) to make out their lamination. This fact of lamination alone differentiates calculus from *gravel,* the latter being

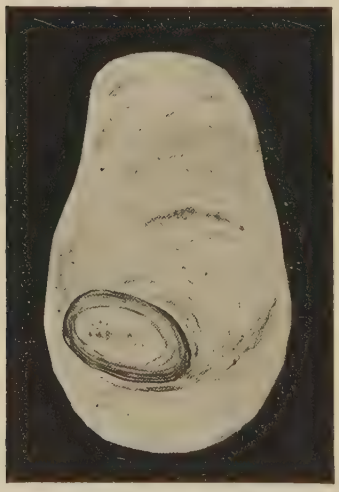

FIG. 76.—SECTION OF A PHOSPHATIC CALCULUS, SHOWING EXCENTRIC DEVELOPMENT.

FIG. 77.—URIC-ACID CALCULUS (SECTION). The marked central lamination suggests a preponderance of uric acid, while the more amorphous periphery shows an intermixture here of urates.

crystalline dust or concretions of crystals more or less large, but not possessed of definite structural arrangement.

The *nucleus* of a stone may consist of whatever, among the organized, crystalline, or earthy constituents of normal or pathological urine,

is capable of concreting into a more or less solid mass; or it may be a foreign substance either coming from within the body or introduced from without. The nucleus is usually in the center of the stone (Figs. 77, 79). An unusual excentric development is shown in Fig. 78.

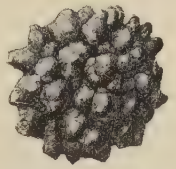

Fig. 78.—Oxalate (Mulberry) Calculus.

The calculus takes its distinguishing title from the salt or salts which enter chiefly into its composition. Thus a phosphatic stone is usually accepted as a stone composed apparently of phosphates, though it may have a nucleus of some other salt (Fig. 79). The classification of stones according to the nature of their nuclei would have its advantages, but it is clinically impracticable.

VARIETIES

The more refined and obscure points relative to the varieties of stone and their pathogenesis cannot be dwelt upon here. My father considered the subject at length in another place.[1] All stones come under one of the following groups:

Primary stone, which develops in an acid urine without any antecedent inflammation, may consist of uric acid, urate of soda, lime, or potash, oxalate of lime, cystin, xanthin, carbonate of lime, crystalline phosphate of lime, or indigo.

Fig. 79.—Section of Calculus of Mixed Uric Acid and Oxalate of Lime, Coated with Phosphates. Such a stone would pass for phosphatic on inspection.

Fig. 80.—Multiple Phosphatic Calculi (Natural Size). The irregular shape is due to friction. There were six similar stones in this case.)

[1] Internat. Encycl. of Surgery (Ashhurst), vol. vi, p. 145.

Secondary stone, which develops in an alkaline urine as the result of inflammation, may consist of ammonio-magnesium phosphate (triple phosphate), amorphous phosphate of lime, tricalcic phosphate, urate of ammonia, or urostealith.

Among the primary stones only those composed of uric acid, oxalate of lime, and urates are common; the other varieties are extremely rare. Secondary stones are commonly formed of mixed phosphates, very rarely of urate of ammonia or urostealith. Primary calculi are usually formed of the same substance throughout, while secondary phosphatic calculi are often found about a primary stone as a nucleus. While the proportions vary in different countries, uric acid forms the nucleus of from 50 per cent to 80 per cent of all stones.

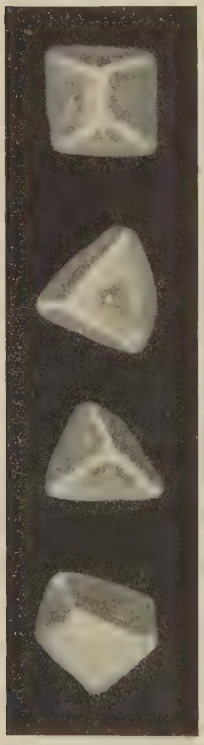

FIG. 81. — MULTIPLE SMALL PHOSPHATIC CALCULI (NATURAL SIZE). These stones are selected from a group of 33 similar ones. These small stones show sharp faceting from friction.

Uric Acid.—Uric-acid stone is the most common in the human subject. It may be mixed intimately or in layers with urates, oxalate of lime, or phosphates. It does not attain a very great size, and may be single or multiple. In structure it is either laminated or amorphous.

The laminated uric-acid stone is of a dark reddish-brown color, very hard and heavy. When cut and polished it resembles an agate, displaying a concentric arrangement of irregularly curved lines of slightly varying color and thickness (Fig. 77). The amorphous variety is much less common. It is rather soft, gritty-looking, and comparatively structureless on section. It is of a reddish-yellow color and composed chiefly of urates, and hence is commonly known as urate stone.

Oxalate.—Oxalate-of-lime stone is commonly single, blackish-brown in color, and very hard. It is usually covered with blunted asperities, whence it has acquired the name of mulberry calculus (Fig. 78). Upon section it shows undulating laminæ, which may vary widely in color, as there is often an admixture of uric acid or phosphates in the composition of this stone (Fig. 79).

Phosphate.—Mixed phosphate or fusible calculus is the common secondary calculus. It may grow to an enormous size, and may be single or multiple (Figs. 79, 80, 81). It forms around a primary calculus, a blood clot, or a foreign body. It is granular, soft, light in weight, and of a dirty white color. It may be amorphous or laminated.

The other forms of calculi are so rare as to require no special mention. Cystinuria has a medical rather than a surgical interest. (Cf. Cohn [1] and Moréigne.[2])

ETIOLOGY

The causes of stone formation are extremely obscure. Secondary (phosphatic)stones are known to result from the changes in the urine commonly known as alkaline fermentation. Such calculi are frequent in old men suffering from the cystitis of prostatic hypertrophy, and are less frequently met with as the result of other forms of inflammation. But the etiology of primary calculus is most obscure. Primary stones are very uncommon in women. The negro is said to be singularly exempt, and there are two periods of life during which they are most frequently found—viz., in the first two and in the fifth decades of life. But the most notable feature of the occurrence of primary stone is its great frequency in certain localities and its comparative rarity in others. Thus India leads the list with hundreds of operations a year. Egypt, perhaps, comes second, and North America is, as a whole, comparatively exempt. Yet in certain parts of India primary calculus is quite as rare as it is with us, and it has also been observed that the tendency to stone among the inhabitants of a certain district seems to increase or decrease regularly over a long period of years. To explain these vagaries various theories have been adduced. The influence of climate, the soil, the water, the civilization of the inhabitants, as affecting their occupations, the diet, especially the amount of salt habitually taken—all of these and various other factors have been implicated.

There is some evidence of a hereditary tendency to stone formation closely allied to the uric-acid diathesis. Indeed, the predisposing cause of primary stone is undoubtedly the presence of crystals in the urine. Without crystals there can be no calculus, yet the urine may contain crystals for years and no stone form. A notable example is the phosphaturia so common in the young. It may continue for years, and the urine may be so thick with phosphates that the terminal drops, if they fall upon the patient's shoe, give the effect of a splash of mortar. Yet phosphatic stone is never due to this phosphaturia. In point of fact, the microscope reveals that a urinary calculus is made up, not of the sharp-pointed crystals so commonly seen in the urine, but of rounded masses, showing neither angles nor polarity, and consisting of an amorphous collection of granules of a urinary salt embedded in a structureless, albuminous substance. If true crystals appear, they occur simply as foreign bodies entrapped in the stone. Rainey and Ord have conclusively shown that the determining cause of calculus is the increased density of the

[1] *Berl. klin. Woch.*, 1899, xxxvi, 503. [2] *Guyon's Annales*, 1899, xvii, 803, 910.

urine and the presence of colloid substances in solution, in conjunction with an excess of urinary salts; for "a crystalloid is deposited from solution in the presence of a colloid," and crystals introduced into a colloidal solution are disintegrated and reformed by simple, molecular coalescence. Thus the nucleus of a stone is always laid down in an albuminous substance. A blood clot, a foreign body surrounded by the muco-pus stirred up by its presence, or the mucoid exudate of a mild infection, may form this nucleus. And once the nucleus has formed, it is always in such a foreign body surrounded by albuminous matter that new layers of stone are constantly being formed.

The rate of growth of a stone must vary greatly, and although it would be most interesting to be able to estimate by the size of a calculus how long it had existed, such an estimate cannot be made with any accuracy. Thus it is known that phosphatic stones grow, as a rule, much faster than primary ones, and yet my father removed a uric-acid calculus weighing 2 ounces from a boy nine years old, and a hairpin from a girl's bladder (in which it had remained for more than a year), which was incrusted with less than a dram of phosphates.

PREVENTIVE AND SOLVENT TREATMENT OF CALCULUS

Inasmuch as the discovery or passage of a single stone suggests the possibility that others may be present or may subsequently form, every case of urinary calculus presents the problem of how to prevent the recurrence of stone, while many patients, moved by the blazon of the Buffalo Lithia bottle, inquire, "How shall I dissolve my stone?"

As an elementary proposition, we may state that urinary calculus cannot be dissolved. Unless it is passed it must be removed. Spontaneous fracture will not help matters.

But medical aids may very properly be invoked under two conditions:

1. To aid the passage of a small ureteral stone (p. 431).
2. To prevent recurrence of stone after all calculi have been passed or removed.

No treatment can guarantee success in either event, but treatment should be conducted along the following lines:

Secondary Stone.—For the prevention of secondary stone we depend upon the cure or control of the inflammation causing it.

Primary Stone.—The treatment includes—

1. Dietetics.
2. Exercise.
3. Encouraging elimination by other avenues.
4. Diluting the urine constantly.
5. Use of solvents, and attempts to dilute the colloids.

But over and above all this, the diagnosis of stone in the kidney must be made, for if a stone remains there it is quite fatuous to attempt to prevent the formation of others in the bladder.

1. **Diet.**—Thompson, who has given this matter much attention, believes that uric-acid formation lies essentially in the liver, and that it is by correcting disease of that organ that we may hope to overcome the diathesis. He adopts, in the main, the Carlsbad notions, and cuts off sugar, fat, and alcohol, rather than the meats. In truth, such a dietary usually proves more effective than the old-fashioned one, which interdicted nitrogenized food because uric acid is a nitrogenized product, overlooking the fact that there is necessarily enough nitrogen eliminated every day in the urine to supply unlimited uric acid, given the colloidal and other conditions upon which the formation of calculus depends.

Practically, then, it is found that a proper diet consists of meat, poultry, fish, eggs, bread, and all the cereals, all the fruits and roots, green vegetables, and salads, with butter and milk in moderation. If any of the above-mentioned articles prove hard to digest, that fact alone is sufficient to condemn it in the individual case.

Sugar is harmful; most wines and liquors are pernicious; sometimes a little light wine is allowable, or gin or old whisky in selected cases. Heller showed that an exclusive diet of rye bread caused all uric acid to disappear from the urine, this substance being replaced by hippuric acid, a solution of which is a natural solvent of uric acid.

2. **Exercise.**—Exercise, probably by improving digestion and giving plenty of oxygen to the blood and tissues, is a factor of generally recognized value in preventing uric-acid formation. It should be pushed to the limit of the patient's capacity and pleasure.

3. **Encouraging Elimination.**—The liver has a large share in uric-acid formation, and, by preventing its becoming what is called torpid, a long stride is made in the preventive treatment of stone. The action of the bowels should therefore be closely attended to. Added to this, a course of Glauber's salts may be given occasionally, or small, graded, prolonged courses of the sulphate-of-soda bitter waters (Hunyadi, Friederichshall). Garrod [1] and Vinay [2] speak strongly in favor of long courses of the benzoates of sodium and potassium for the purpose of acting as uric-acid solvents. Robin [3] speaks highly of piperazin, administering a tablespoonful of a 1-per-cent solution twice a day, *p. c.*, for three days in the week.

Klemperer [4] advises mineral waters if the tendency is to urates, and gives 0.5 gram of Epsom salts twice a day for the control of oxalates. Van Noorden and Croftan [5] administer calcium carbonate in doses of

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[1] *Lancet*, 1883, i, 670.
[2] *Lyon méd.*, January 3, 1904.
[3] *Bull. gen. de thérap.*, 1902, cxliv.
[4] *Therap. d. Gegenwart*, 1904, xlv, No. 8.
[5] *Jour. Am. Med. Assoc.*, 1903, xl, 818.

1 to 15 grams, *t. i. d.*, or in the form of Contrexeville, Wildungen, or Fachingen water.

Harrison [1] and Watson [2] are strong advocates of turpentine.

4. **Dilution.**—Many persons prone to discharge uric acid and urates in excess and to have concentrated urine, are not free drinkers of water, and for such persons much may be done by encouraging them to take a glass of water between meals and another on retiring. This renders the urine by so much the more dilute, and thus militates against percipitation of the urinary salts. Filtered rain water is better than ordinary water for this purpose. Distilled water is excellent, and some of the unaërated mineral-spring waters better still; after being charged with carbonic-acid gas, their diuretic property is much lessened.

5. **Solvents.**—A quick way to dissolve acids in the urine is to administer alkaline medicines, particularly those that also have a diuretic effect, such as the acetate or the citrate of potash. Here belong also all the alkaline salts and the alkaline mineral waters. As a preventive of stone formation, the alkaline method is defective in that it is by no means essential, and in many instances, if long continued, it finally ceases to act, or may have the further harmful effect of disturbing digestion, and sometimes directly causing anemia. When alkaline medicines are given, it must be remembered that they produce their maximum effect if administered about two hours after the end of a meal. The borocitrate of magnesia in about 1-gram doses, three times a day, is well borne if a long course of alkaline medicine is desired.

The so-called uric-acid solvents are more satisfactory. They have the advantage of being better borne by the stomach and of acting best when given in interrupted courses—a month of medication followed by a month of rest. Hexamethylenamin, piperazin, and Contrexeville water are useful. They need not be taken for a lifetime, but only during those periods when the urinary specific gravity and acidity run high.

Crystals of oxalate of lime do not cease to appear under an alkaline course. Dilute mineral acids, exercise, and air are the best means with which to fight this tendency. Beale believes that the free use of carbonate of ammonium will prevent cystin formations.

To dilute the colloids, which seem to preside over crystallization, all that at present can be done is to keep the urine dilute and bland, and the digestion perfect, to prevent catarrhal conditions of the stomach and intestine, and to avert feverishness from whatever cause.

To sum up, my directions to patients are habitually as follows: 1. Eat lightly. Take meat but once a day. Eschew sweet foods, fried foods, and, above all, such foods as interfere with digestion. 2. Drink no wines but white wines; no liquors but gin and whisky—these in mod-

[1] *Brit. Med. Jour.*, January 17, 1903. [2] Watson and Cunningham, i, 188.

eration. Drink plenty of water (any flat mineral water will do, and the patient will drink it more faithfully because it comes in bottles). 3. Exercise freely at all times, and in the open air. 4. Keep the bowels regular. 5. Alkalies or solvents I prescribe with little hope that the patient will continue to use them.

The Electrolytic Treatment of Stone.—Although the electric current influences crystallization, and although Bouvier-Demortiers, Dumas, Prévost, and Erckmann have shown that stone may be pierced and disintegrated by the galvanic current, yet the method is a failure for all practical purposes, and not worthy of adoption under any known circumstances.

The Solvent Treatment of Stone.—Since Pliny's ashes of snail shells even to the present day, the wise and the foolish alike have searched unceasingly for something which, taken by the mouth, might be capable of dissolving a stone in the kidney or the bladder, and the substance has not been found. The Joanna Stephens remedies worked wonders in the last century, until Parliament bought the secret for £5,000, after which they quickly fell into disuse and are now forgotten. Each of the four patients, whose cures were attested by the trustees appointed by Government to investigate the matter, died with stone in the bladder, as proved by autopsy.

CHAPTER XXXVIII

RENAL AND URETERAL CALCULUS

Calculi occupying the kidney pelvis or calices are spoken of as renal; those occupying the ureter are called ureteral calculi. All ureter calculi are actually renal calculi that have slipped down from the pelvis of the kidney and caught in the ureter. It is an open question what proportion of vesical calculi originate in the kidney and pass silently into the bladder.

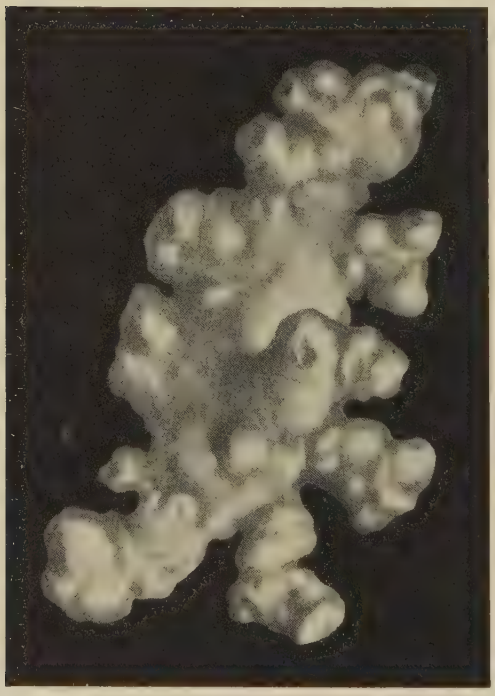

Fig. 82.—Large Branched Renal Calculus.

Renal calculi are usually single. Exceptionally a great number of stones are found. Thus Morris removed 200 stones from one kidney and Dessirier and Legrand found 400 calculi in the left kidney and 60 in the right at the autopsy of a young soldier who during life had shown no symptoms referable to the kidneys. Renal calculi run up to about 100 grams (3 ounces) in weight, the large stones being irregularly branched to fit into the distorted and dilated pelvis and calices (Fig. 82).[1] In operating upon a suppurating kidney one occasionally meets with very small stones, scarcely more than phosphatic grit. A pupy magma is also sometimes encountered.

Kraft found renal calculi 40 times in 2,953 autopsies; both kidneys were affected 15 times. Legueu and Albarran agree that in about

[1] Watson and Cunningham depict a calculus that weighed one and a half pounds.

half the cases both kidneys contain calculi, yet recent X-ray investigations go to show that in the living the proportion of bilateral cases is not so great.

Ureteral calculi are ovoidal in shape. If multiple and in contact they are faceted, but they are almost always elongated in one diameter and therefore do not throw a round shadow under the Roentgen ray, a fact of great importance in the study of such shadows.

The relative frequency of renal and ureteral calculi is still a question for dispute. In the preradiographic period the preponderance of renal over ureteral calculi was notable. To-day the radiographer finds most calculi in the ureter. Thus Leonard [1] found calculi 36 times in the renal pelvis against 70 times in the ureter.

The X-ray catches the stone in transit, as it were, for all renal and ureteral stones originate in the renal pelvis, and of those seen by the radiographer in the ureter the greater number (31 out of Leonard's 46 cases) are passed spontaneously.

The points in the ureter where a calculus is most likely to be caught are:

1. One to two cm. below the renal pelvis.
2. At the brim of the bony pelvis.
3. At the lower end of the ureter, within its ultimate 5 cm., less often in its course through the bladder wall.

PATHOLOGY

The changes that a calculus may undergo, such as phosphatic incrustation, spontaneous fracture, etc., have been described.

The changes that occur in the kidneys and ureters from the presence of calculi may be considered under three heads—viz., retention, ulceration, and inflammation.

Retention.—A calculus formed in the renal pelvis may at any moment slip down and be caught at the orifice of the ureter, or at any physiological or pathological narrowing in that duct. Such an impaction may be partial or complete. It is usually partial, and as the urine dammed up behind this sudden obstacle brings pressure upon it, the stone is forcibly driven into the ureter, setting up a *renal colic.* This is relieved by the passage of the stone into the bladder, by its slipping back into the pelvis, or by the gradual accommodation of the parts to the new conditions. If the stone remains impacted it causes either partial retention resulting in *hydronephrosis,* or complete retention resulting in an acute anuria and subsequent atrophy of the kidney (unless the obstruction is relieved). This complete retention is evinced by *anuria*—

[1] *Jour. Am. Med. Assoc.,* 1907, xlix, 1094, and *ibid.,* 1909, lii, 289.

calculous anuria it is called—which is partial or temporary if the opposite kidney is able to continue its functions, permanent and fatal if the opposite kidney stops secreting, whether on account of reflex congestion or of bilateral calculous obstruction.

Ulceration.—Ulceration occurs at whatever point in the kidney, the pelvis, or the ureter a stone may rest. If the stone is small and movable the ulceration may be insignificant. If it is large or impacted, the ulceration may be so deep and extensive that actual *perforation* occurs, permitting the stone to escape from the kidney (the pelvis or the ureter) into the surrounding tissues. This complication, associated as it is with urinary extravasation, is as unusual as it is grave. *Ureteral stricture* may result from prolonged calculous impaction.

Inflammation.—A more common—in fact, *the* most common—effect of ulceration is infection. The congested ulcerated spot and the stone itself, coated with the muco-serous exudate, form admirable breeding-places for bacteria, and if there is retention to cause a general congestion, so much the more likely is it that infection will occur. The infection is habitually descending and spontaneous. While the resulting pyelo-nephritis may assume a catarrhal form, and perhaps is usually of that nature at first, the surgeon sees it only after the suppurative stage is reached: *suppurative pyelo-nephritis* or *pyonephrosis*. It is futile to attempt the enumeration of the various lesions that may be caused by one or more stones in the various portions of the upper urinary tract. The lesions of retention, ulceration, and inflammation are combined in endless variety. There may be only localized suppuration about a small pelvic calculus, or there may be numerous calculous pockets throughout the kidney; the entire organ may be reduced to a multilocular abscess cavity filled by a great branching stone (Fig. 85). The kidney may be found atrophied, and closely contracted around a stone that had caused complete obstruction years before. Pyonephrosis results from obstruction of the ureter by stone or stricture when there is infection. Suppuration within the organ may be associated with *perinephritis* from extension of the inflammation or from rupture of the sac. The longer the disease continues the more extensive the destruction of renal tissue and the greater the likelihood of bilateral calculous disease.

SYMPTOMS

Any general discussion of the symptoms of renal calculus must be prefaced by the statement that the condition may exist for years without causing any symptoms whatever. The influence that this fact must have upon diagnosis and therapeusis will be considered later.

Morris mentions the notable symptoms caused by renal calculus in 103 cases of his own. These he tabulates as follows:

Pain occurred in	71	cases	(69 per cent).
Pyuria occurred in	50	"	(48 per cent).
Renal colic occurred in	44	"	(43 per cent).
Hematuria occurred in	41	"	(40 per cent).
Tumor occurred in	27	"	(26 per cent).
Troubles of micturition occurred in	24	"	(23 per cent).
Tenderness occurred in	17	"	(16 per cent)

Pain.—Of calculous diseases, Morris writes: "They are the most frequent and most painful of surgical diseases of the kidney. Probably no disease, except acute tetanus, is capable of causing worse suffering." The various pains due to renal and ureteral calculi are renal colic, pressure pains, and reflex pains.

Renal Colic.—This is the most characteristic symptom of stone in the kidney. It is due to the impaction of a stone in the ureter. The pain is paroxysmal in character. It commences suddenly, at any time, when the patient is seemingly in the best of health, perhaps most frequently shortly after rising in the morning. It shoots down the ureter into the scrotum and to the end of the penis. The testicle of the affected side is often strongly retracted. Indeed, the entire scrotum and penis may be drawn up into a hard knot, as it were. The pain may also extend down the thigh on the affected side. There is usually an incessant desire to pass water, although there is almost absolute suppression. What little urine is voided comes away high-colored and in small quantities at a time, often tinged with blood and mixed with epithelium from the kidney. Pain attends urination, chiefly toward its close, running down to the end of the penis. If the paroxysm is severe, faintness, nausea, and vomiting occur, the skin is covered with a cold sweat, the patient tosses restlessly about, seeking relief, but finding none. In the intervals between paroxysms there is a sense of soreness and discomfort perhaps amounting to continued pain, or the relief may be absolute. After one or more paroxysms, lasting from a few hours to many days, all pain suddenly ceases. This sudden cessation indicates that the stone has been liberated. It may have fallen back into the pelvis of the kidney, have passed down into the bladder, or have reached some dilated portion of the ureter, where it rests without interrupting the urinary outflow.

The nature of the *termination* of an attack may usually be diagnosed from the symptoms. If the calculus remains in the ureter some pain and tenderness usually persist at the point where it rests. If the impaction has occurred at the upper end of the ureter and is relieved by the stone slipping back into the pelvis, the pain during the attack is usually most intense in the loin and radiates across the back as much as down the ureter. On the other hand, if the stone travels down the

ureter to the bladder, its descent is often marked by a progression of the pain from the loin to the pelvis—a progression which may be interrupted by periods of relative or absolute ease—with a corresponding increase in the vesical irritability and the pain and retraction of the testicle.

It may be here remarked that the period of calm following an attack of renal colic should be a time of utmost vigilance on the part of the surgeon (p. 433).

Pressure Pains.—When the stone is in such a position or of such a size as to fill the cavity in which it lies, it commonly causes a dull continuous ache associated with tenderness. This ache is not necessarily severe; indeed, some persons will endure it for years without attaching any great importance to it, but to the surgeon it is of the utmost importance. The history of such an ache, whether past or present, especially if associated with a point of local tenderness, may be the chief symptom determining the location of the stone.

Reflex Pains.—The two most notable renal reflex pains excited by stone are: (1) Pain following the course of the ureter into the pelvis and thence radiating to the testicle and thigh, and (2) painful and frequent urination. Both reflexes originate from distention or irritation of the pelvis or the ureter rather than from the kidney proper,[1] and may rarely occur from any irritation other than stone.

The painful and frequent urination that so often misleads the surgeon into the belief that the bladder is diseased can only be distinguished by a careful examination of the patient and the urine. This symptom occurred in 23 per cent of Morris's cases.

It is questionable whether stone in one kidney may give pain referred only to the opposite organ. Morris, who has had more experience in this malady than any other surgeon, says: "There is not, so far as I know, any case on record in which there is completely satisfactory evidence of symptoms on one side only being caused by a stone in the kidney of the opposite side. The presence of a stone on one [2] side is not proof that the opposite and painful side is not also affected. That the attacks referred to one side have ceased after operating upon the opposite and painless side is not conclusive; this may be a coincidence due either to the accidental shifting of a calculus in the painful kidney or to the calculus becoming lodged in some immovable manner. There may be very advanced disease of the kidney on the painful side and a symptomless calculus in the opposite kidney." And again: "It is important to know that a stone in one kidney will sometimes excite sympathetic pain and irritation in the other; but this transferred or sympathetic pain is of an aching character, not of a spasmodic or colicky description, is only occa-

[1] I cannot accept Bryson's theory that vesical pains are always due to irritation at the lower end of the ureter.

[2] Painless.

sional, and never occurs except as an accompaniment of more severe pain on the affected side."

My own experience agrees with this. Misleading "crossed" pain we often see, but in my patients it has always been due to some concomitant lesion on the opposite side (p. 371).

Hematuria.—As shown by the table, considerable hematuria is a fairly constant symptom of stone. Yet it is variable to the last degree. Some hematuria usually accompanies and follows a renal colic, and in most cases there is a fairly constant oozing of blood, showing itself only by the presence of a few red cells and a trace of albumin in the urine. Blood casts and long ureteral clots rarely occur. The bleeding is usually made worse by exercise (though the pain is not), and hence the presence of a great number of red cells in the sediment centrifuged from the urine passed after exercise is suggestive of stone. But, after all, the hemorrhage caused by renal stone is an inconstant symptom.

The remaining symptoms on the list require no notice here.

COURSE OF THE DISEASE

The course of the disease is entirely irregular. The character of the symptoms bears no relation to the size or position of the stone; and the progress of the disease varies from the cases that have only a single fatal attack of calculous anuria to those that drag on for years with chronic renal suppuration, or that die of some intercurrent disease without ever having manifested any symptom referable to the calculi with which their kidneys are filled.

Several types of the disease may be mentioned, due allowance being made for the fact that the clinical aspect of any given case is often a compound of several types. The surgeon encounters: (1) Cases without symptoms, (2) cases of renal colic, (3) cases of calculous anuria, (4) cases of renal distention, and (5) cases of renal suppuration.

Cases without Symptoms.—Morris distinguishes cases without symptoms from quiescent cases that have shown symptoms (e. g., renal colic) at some previous time. Clinically the conditions are much the same. After several years have intervened it may be impossible to obtain a convincing history of even so impressive an attack as a renal colic. Moreover, a stone may certainly remain for many years unsuspected in the kidney, and at the end of that time set up calculous anuria or perinephritic abscess, or any other form of calculous trouble. The clinical warning impressed by these cases is that after a renal colic or after any other manifestation of stone in the kidney, the subsidence of symptoms is no evidence that the stone has passed. In such a case it is the surgeon's duty to *find out* that the stone has passed. (Cf. Diagnosis.)

Cole has noted that small stones often produce more acute symptoms than large ones. This is due to the fact that a small stone may become impacted in the ureter; but if the stone lying in the renal pelvis attains considerable size without becoming impacted, it can no longer totally occlude the ureter.

Renal Colic and Other Pains.—When the calculus does begin to give symptoms, pain of one sort or another becomes a feature of the disease. A renal colic is often the initial symptom of stone. A single colic may result in the passage of the offending stone; or the stone may remain quiescent for years thereafter, or give rise to repeated attacks of colic, or to a continuous dull pain. The attacks of colic may be singularly regular in their recurrence. I have encountered a case in which the paroxysms recurred every Sunday afternoon for several weeks; but this systematic recurrence is always suggestive of a neurosis rather than of a straightforward calculous colic. Other cases run their course with no other notable symptom than a constant ache in the loin. There may or may not be intercurrent attacks of colic or other pains.

Other cases again give only reflex symptoms. One of my earliest professional recollections is of an old man who for years suffered only from painful and frequent urination. His bladder was washed, searched, sounded, and even cut—all to no avail. New York's best surgeons of those days could do nothing for him. Finally, his protracted agony was terminated by a fatal attack of suppression of urine, as it was called. Autopsy revealed a normal bladder and one kidney atrophied and tightly contracted about a calculus, the other somewhat dilated and with a stone plugging the ureteral orifice. Yet he had never complained of a symptom referable to either kidney.

Calculous Anuria.—Calculous anuria is a cessation of the urinary flow caused by the plugging of one or both ureters with calculi. It is part suppression, part retention. The terminal anuria in the case mentioned above was a pure retention. One kidney had been out of commission for years; the flow of urine from the other was stopped by the obstructing stone. In other cases the blockage of one ureter throws such a burden of excretion upon the opposite kidney that it becomes acutely congested, and suppression ensues. Thus anuria may ensue (1) when both ureters are completely obstructed, or (2) when one ureter is obstructed and the opposite kidney absent, hypertrophied, or sufficiently diseased to be incapable of enduring the congestion forced upon it. The acute obstruction is clinically unilateral, but unless both kidneys are diseased anuria—prolonged anuria, at least—does not occur.

Pathology.—The pathology of calculous anuria is striking and characteristic. The affected kidney, which may be hydronephrotic or suppurating, is intensely congested (Fig. 83). It is enlarged to twice or thrice its normal size, dark in color, and mottled. On

section its tissues are found friable and edematous. Such a large, soft, purple organ once seen is never forgotten.

The opposite kidney (Fig. 84)—if there is one—may undergo like changes in a less degree, but the absence of congestion in it may be in striking contrast to its fellow. In all but 3 of the 58 cases collected by Morris, the opposite kidney was absent or completely disorganized.

Symptoms.—The symptoms of calculous anuria may be divided into three stages: 1. The Premonitory Stage. 2. The Tolerant Stage. 3. The Uremic Stage.

1. In the *premonitory stage* there is more or less pain, perhaps an actual colic, referred to the kidney. Happily this pain always occurs, for it is the chief sign by which the surgeon is able to decide which kidney most requires operation. It persists from a few hours to a few days.

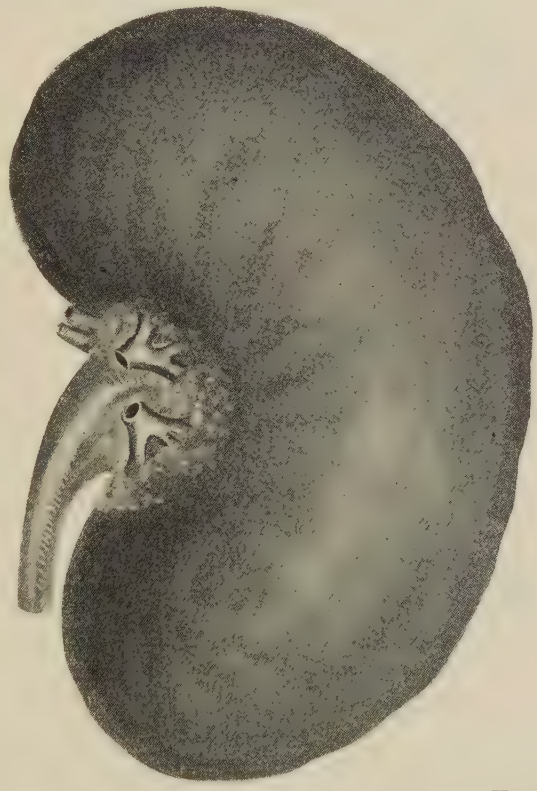

Fig. 83.—Calculous Anuria; The Congested Kidney. The stone was impacted lower down the ureter. (Compare Fig. 84.)

2. The *tolerant stage* is characterized by but one symptom—viz., anuria. The patient does not pass water. This anuria is rarely absolute. A few grams of urine tinged with blood are passed every day, or perhaps the anuria runs a remittent course. At one time or another 2 or 3 liters of urine may gush forth, a misleading promise of relief, for the flow is but temporary. This state of affairs lasts from three days to a week. *Not a drop of urine may be passed during several days and yet the patient may, apparently, remain in the best of health.* No more striking contrast could well be imagined than that presented by calculous anuria: on the one hand, the grave renal lesion, the absolute retention, the swift fulminating character of the uremic period soon to follow; and, on the other hand, this entire absence of symptoms, local or general. The patient goes about well

content. He eats, sleeps, and works pretty much as usual. Whatever pain he has had in the loin is past, and his present discomforts are insignificant. And yet all the while there is brewing within him a crisis swift and terrible.

Spontaneous recovery may occur. The obstruction is relieved; the urine gushes out, 3 or 4 liters a day, and all is well. This may occur in 20.8 per cent (Morris) to 28.5 per cent (Legueu) of all cases. In Legueu's [1] cases the spontaneous cure took place on the third day once, between the fifth and the tenth day twice; later still in five instances. Yet it is obvious (cf. Treatment) that no time should be lost in the expectation of a spontaneous cure; for even if this occurs, unless the calculus is actually passed, the patient thereafter goes about in imminent danger of a recurrence of his attack.

When spontaneous recovery does not occur the patient passes into the third stage of the disease at the end of a week or ten days.

3. The *uremic stage* is usually ushered in by hiccough or vomiting. This is the first warning. It may continue for a day or two without additional symptoms. The pulse is tense, the temperature usually subnormal. Constipation becomes absolute and the intestines are distended with gas. The vomiting grows more severe, the intellect becomes dulled and stuporous. The patient's mind may wander a little, and he may even have maniacal attacks. There is often a restlessness of both mind and body. And thus he sinks away and dies, often within two or three days of the first hiccough or vomiting.

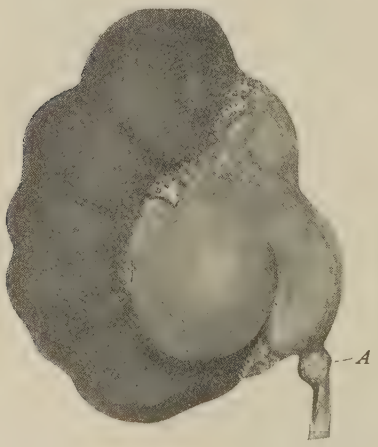

Fig. 84.—Calculous Hydronephrosis. A small stone was found lodged at *A*. This kidney is the fellow of the one shown in Fig. 83. They were obtained from a patient who died of calculous anuria.

Such is the clinical picture of what Morris has aptly termed the gravest and most fatal of the many serious complications of urinary lithiasis. Of course there are atypical cases: the obstruction may be intermittent or partial; but such cases require no special notice.

Calculous Hydronephrosis.—Calculous hydronephrosis is due to the impaction of a stone in the ureter (Fig. 84), or rarely to a stricture secondary to calculous ulceration. The development of the hydronephrosis is habitually marked by a series of renal colics, and hydronephrosis may be one of the features of cal-

[1] *Guyon's Annales*, 1895, xiii, 865.

culous anuria. The symptoms and signs of hydronephrosis are detailed elsewhere.

Renal Suppuration.—Stone in the kidney is probably the most common cause of suppurating pyelo-nephritis. It also causes pyonephrosis (Fig. 85); while secondary phosphatic calculus or phosphatic deposit upon a preëxisting calculus results from the inflammation. Catarrhal inflammation is not encountered with calculus. The irritation caused by the stone is such that when inflammation occurs it promptly assumes a suppurative type.

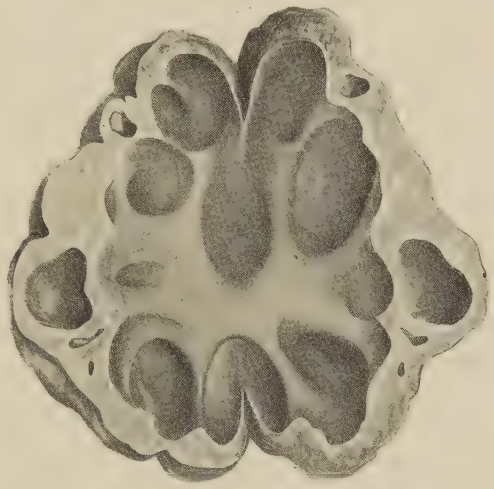

Fig. 85.—Calculous Pyonephrosis. This kidney contained the stone shown in Fig. 82.

The variations imprinted upon the classical picture of suppurative pyelo-nephritis by the presence of stone are few. There is the same urinary septicemia, the same absence of any great enlargement of the kidney. There may be colic, and there is usually a constant ache in the side. Hemorrhages occur from time to time. The inflammation is rarely acute or virulent, but progresses slowly, involving the whole organ and terminating finally in pyonephrosis or perinephritic abscess.

DIAGNOSIS

The accurate diagnosis of stone in the kidney pelvis or the ureter must cover the following points:

(1) The presence or absence of stone.
(2) The number, position, and distribution of stones.
(3) The presence or absence of renal infection.
(4) The functional capacity of both kidneys.

In order to make this diagnosis, familiarity with radiography and with the methods of testing the renal function is essential. Without the X-ray and the ureter catheter it is possible, in certain cases, to diagnose the presence of stone with some accuracy and to operate for its relief with some success; but both methods are necessary in order to insure good work in all cases, and in order to insure any diagnosis at all in some.

The most typical history of renal stone, even if accompanied by

characteristic gross evidences of such conditions as pyonephrosis or calculous anuria, is not enough to indicate to the surgeon such important facts as the position and number of the stones present, or the functional capacity of the opposite kidney; and most cases first apply for relief at a time when the history is anything but characteristic, the physical signs anything but adequate to insure appropriate treatment.

The following table, which has been prepared by Dr. Charles Eastmond as a result of his radiographic experiences, indicates quite accurately how often the symptoms and physical signs are misleading as to the presence or absence of stone. They are still more often misleading as to the condition of the kidneys.

TOTAL CASES, 80 { Calculus present....23 = (28.75%); Negative.....57 = (71.25%)

23 cases of calculi:
- With typical symptoms (renal) 8
  (Two had additional calculi in opposite kidney.)
- With indefinite symptoms..... 9
- With symptoms on opposite side to calculus..... 3
- With symptoms referred to other parts..... 3
  (Of these, two had renal symptoms with calculi in the bladder; one vesical symptoms with calculus in kidney.)

53 with typical symptoms { calculi.....14 = (24.14%); calculi in suspected region..... 8 = (13.79%)

22 with indefinite symptoms—calculi..... 9 = (40.90%)

URINE

			Pus.	*Blood.*	*Both.*	*None.*	*Total.*	
23 with calculus	Typical symptoms with calculi	+ sand[1]	1	1	1	1	4	8 = (34.78%)
		0 sand	1	2	0	1	4	
	Symptoms vague or referred to other points than site of calculus	+ sand	2	1	2	0	5	15 = (65.22%)
		0 sand	5	1	0	4	10	
			9	5	3	6		
57 negative	Typical symptoms—O calculi	+ sand	3	6	4	5	18	44 = (77.19%)
		0 sand	5	4	8	9	26	
	Vague symptoms—O calculi	+ sand	0	3	0	6	9	13
		0 sand	1	1	2	0	4	
			18	19	17	26	80	

Our means of diagnosis may be summed up under the following heads, in the order of their employment:

(1) The patient's history.
(2) Physical examination and urinalysis.
(3) Radiography.
(4) Substitutes for radiography.
(5) Ureteral catheterism.
(6) Exploratory operation.

[1] History or present evidence of the passage of stone, gravel, sand, or crystals.

Patient's History.—The presence of calculus is suggested by history of the passage of stone, of renal colic, of anuria, or by the presence or history of stone in the bladder. Every case of pyelo-nephritis is suspected to be calculous until the absence of calculus has been proven by radiography. Yet how misleading the history may be is shown by the table given above.

Physical Examination and Urinalysis.—The presence of stone in the bladder or of pyelo-nephritis or pyonephrosis suggest the possibility of renal or ureteral stone. It is exceptionally possible to palpate through the vagina or the rectum large stones incarcerated at the lower end of the ureter, and it is even rarer to distinguish a point of localized abdominal tenderness along the course of the ureter where a stone is lodged.

Urinalysis suggests stone when crystals of uric acid or oxalate of lime are present in great numbers, especially if these are found in the rounded forms. A relatively high percentage of urea in relation to the urinary specific gravity is suggestive of stone, and the presence of blood cells with crystals in the urine is peculiarly suggestive. Yet the passage of crystals alone often causes renal colic and may even produce a macroscopic hemorrhage. Moreover, while the rule is almost universal that, so long as stone is present in the upper urinary tract, there are constantly a few blood cells in the urine, I have known two notable exceptions to this rule: i. e., two cases in which stone was present but the urine showed no red-blood cells. On the other hand, microscopic traces of blood are constantly found in the urine as a result of so many conditions other than renal stone that the presence of blood cells alone is no more than suggestive.

The presence of tubercle bacilli in the urine does not exclude stone, for secondary stone formation may occur in a tuberculous kidney.

Radiography.—A good radiograph is the surest evidence in the diagnosis of renal and ureteral stone. (Figs. 86, 87 and Pl. VI.)

A good radiograph is one which shows the eleventh and twelfth ribs and the transverse processes of the lumbar vertebræ to their tips, also a distinct shadow of the psoas muscles. No matter in what part of the urinary tract the stone is suspected to lie, the radiographic field should cover the whole urinary tract from above the eleventh rib to the pubes. If the plate is an excellent one, it usually shows the shadow of the kidneys.

The technic of radiography for stone is too broad a subject to be discussed here even in an elementary manner. The best operators follow their own special technic. As a general rule it is safer to use at least three, and at most five, plates to cover the urinary tract, and if some special point is peculiarly suspicious, an additional duplicate plate should be devoted to this. Although it is the universal custom to place

the film of the plate next the patient's body, it is also advisable to indicate the side by a letter R or L, since the plate may have been put in its envelope wrong side in front.

The density of the shadow thrown by stone depends chiefly upon the amount of lime this contains; hence, oxalate and phosphate stones show

FIG. 86.—LARGE RENAL CALCULI. Radiograph by Dr. MacKee. The patient's only symptom was an occasional renal colic. General health excellent. Refuses operation.

well, while pure uric-acid and cystin stones are quite indistinguishable, since their density is approximately that of the body tissues. Yet pure uric-acid stones are extremely rare. The so-called uric-acid stones are almost always intermingled with oxalates or covered by phosphates.

An expert radiographer may be depended upon to give an accurate diagnosis of stone, both as to size, shape, number, and distribution, in about 95 per cent of cases. The 5 per cent of failures is attributable either to the patient himself or to the stone.

The difficulties in reference to the patient are:

(1) The presence of feces or large amounts of gas in the intestines (an ounce of castor oil should be administered the night before the examination, in order to overcome this difficulty).

(2) Obesity. It is the general experience that if a patient measures more than 30 cm. through the abdomen a satisfactory radiograph is not

likely to be obtained. Yet the effort to obtain a good picture is worth making, even in the most obese patient, for surprisingly accurate negatives may occasionally be produced on the most unpromising subjects.

(3) Lack of fat. Some lean subjects are very hard to radiograph. This is probably due to the absence of any fat as a relief to the outlines of the more solid tissues.

Interpretation of Radiographs. The plate should be examined with the film toward the examiner. It should either be placed in a special

FIG. 87.—STYLETTED CATHETER IN RIGHT URETER, PAINTED CATHETER IN LEFT URETER (VAGUE BROAD SHADOW). Radiograph by Dr. MacKee. Note the distance between the catheters and the ischial spines (about which cluster the adventitious pelvic shadows, which do not show well in the print).

camera or examined against a strong light, the plate being held at arm's length and somewhat obliquely. The radiographer himself is more competent to interpret his own plate than is anyone else.

Certain shadows are positively characteristic of stone. Such shadows are thrown by large stones filling the renal pelvis and more or less assuming its shape, or multiple stones, whether in the pelvis or in the ureter. Ureteral stones are always oblong if the stone is large enough to stick in the ureter. Small, absolutely round shadows may represent stones in the passage, but are much more likely to be produced by substances other than renal calculi. Among such substances may be mentioned phleboliths in the pelvic veins, calcified spots in the pelvic ligaments, calcified mesenteric glands, concretions in the appendix.

Aids to Radioscopic Diagnosis.—The little rounded shadows (Fig. 87) which so commonly appear in the pelvis, simulating calculi in the pelvic portion of the ureter, are commonly due to calcified areas in the pelvic ligament or phleboliths in the pelvic veins. They are always rounded (whereas ureteral calculi, unless extremely small, are always elongated), and usually cluster about the outer edge of the pelvis, especially about the spine of the ischium, external to the course of the ureter.

In order to make a diagnosis it is, however, sometimes necessary to take a second radiograph after catheterization of the ureter with a visible ureter catheter. The visible ureter catheter is one into which a metallic wire has been threaded, or which is coated with metallic paint, or into which a saturated solution of argyrol has been injected. Plate VI shows how necessary this test may be to the diagnosis, even when the supposed calculus is in the situation of the abdominal portion of the ureter.

Substitutes for Radiography.—Inasmuch as cystoscopy and ureter catheterism form an essential part of the diagnosis, we need not consider them under the head of substitutes for radiography. If a radiograph fails to show stone, and the patient's symptoms are, nevertheless, inexplicable on any other theory except the presence of stone, there are three tests for confirming or rejecting the diagnosis:

(1) The wax-tipped catheter.
(2) The resonator.
(3) The Bierhoff test.

The Wax-tipped Catheter.—The wax-tipped catheter devised by Kelly consists of a ureter catheter the tip of which has been dipped in melted dentist's wax. This tip should be carefully examined with a magnifying glass before the instrument is introduced, to be sure it is not scratched. It can be employed satisfactorily only with the direct-vision cystoscope, and best with Kelly's cystoscope.

The catheter is introduced into the pelvis of the kidney, withdrawn, and its tip carefully examined with the magnifying glass for longitudinal scratches. If it has touched a stone in the ureter or renal pelvis, it shows minute longitudinal furrows at the point of contact.

Radiograph in Diagnosis of Suspected Renal Calculus.

The patient had an ancient urethral stricture and suffered from vague lumbar pain, while the urine showed mild pyelonephritis (pus, bacteria, albumin, and casts). Radiography showed what appeared to be a stone in the upper part of the left ureter and the functional tests (Fig. 43, p. 89) revealed deficient function of the left kidney. Both pelves were accordingly injected with argyrol (p. 511) and a radiograph (Plate VI) obtained, which showed both pelves undilated, the right ureter (left in plate) dropping normally in a straight line, while the left (right in plate) curved outward, evidently adherent to the lower pole of the kidney, leaving the shadow of the supposed stone between it and the spine. The pyelonephritis and the slight functional inactivity of the left kidney (due to ureteral adhesions) were thus shown to be due to infection from the urethral retention and not to stone.

Kelly has recently suggested that the position of the stone may be identified by coating several centimeters of the catheter with wax, introducing the catheter to a known distance, and then noting how far the scratches extend up the shaft of the instrument. Too much reliance should not be placed upon such a test, since small stones, such as require this test, are very mobile and may be multiple.

The wax-tipped catheter is an uncertain means of diagnosis, since the stone may be in such a position as not to be touched by the catheter, or it may be covered with pus or mucus. Indeed, if the catheter is passed several times upon a given case, it may be noted that sometimes it is scratched, sometimes not.

The Resonator.—Follen Cabot, Newman, and others have devised metallic bougies to be introduced into the ureter through the cystoscope, and to the outer end of which may be attached resonators for the detection of the click when the metallic instrument encounters a stone. The use of this instrument is surrounded with obvious difficulties, yet it might conceivably lead to a diagnosis in rare instances.

Bierhoff's Test.[1]—Bierhoff has suggested that if the pelvis of the kidney is distended with fluid by means of ureter catheterism, the presence of stone is disclosed by the resulting hemorrhage, which lasts for many hours. This test is surprisingly accurate, yet by no means infallible. It only discloses renal calculi; it may excite bleeding from ulceration or neoplasm; and it is possible to confuse with it the prolonged bleeding which very rarely follows the passage of the ureter catheter. On the other hand, I have once known this test to fail when stone was present in the renal pelvis.

Ureter Catheterism.—The cystoscope sometimes reveals a stone protruding from the mouth of the ureter or bulging from the ureter orifice into the bladder. It, moreover, reveals the presence or absence of ureteritis, whether due to stone or not, as described in Chapter V.

The passage of a ureter catheter may be interfered with by stone, yet the fact that the catheter will not pass is more often due to other causes than to stone, whereas even a large ureteral stone may permit the passage of the catheter.

The visible ureter catheter is employed in the diagnosis of stone, as already suggested; but the great virtue of catheterism of the ureter, in the presence of renal or ureteral stone, is the discovery of the functional capacity of the kidney. Even to-day one occasionally sees patients from whom ureteral calculi have been removed because they were shown by the X-ray, when ureter catheterism would have disclosed the fact that the kidney above the calculus was totally disorganized and should be removed.

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[1] *Journal of Urology*, March, 1906, p. 233.

Even with the aid of all the modern methods of diagnosis it is difficult to be certain whether, in operating for a renal calculus, we shall be called upon to perform nephrectomy or not; and it is, therefore, essential to know before the operation the condition of both kidneys as regards infection and functional capacity, so that we may be fully justified in performing, or in refusing to perform, nephrectomy.

Exploratory Operation.—In case of great emergency, whether from anuria or sepsis, there may be no opportunity for submitting the patient to radiography or ureter catheterism before operation. In such an event, one cannot be sure of the position or number of stones present, and therefore the operation should be directed toward relieving the surgical condition regardless of the stone. Whatever operation is performed should usually be bilateral, for since the symptoms may be shifted to the sound side, the wrong kidney may be operated upon unless both are exposed. Before nephrectomy is performed, under such emergency conditions, the opposite kidney should, of course, be exposed and palpated.

The old-fashioned operation of needling the kidney and exploring all of its recesses and the ureter, in the vague hope of finding a possible stone, should be entirely replaced by the modern methods of precise diagnosis.

DIFFERENTIAL DIAGNOSIS

So varied is the symptomatology of renal calculus that it is often overlooked entirely, and more often mistaken for some other malady.

It must be distinguished from other causes of abdominal pain and colic both within (passage of crystals, pyonephrosis, tuberculosis, hydronephrosis) and without the urinary tract (appendicitis, cholecystitis, vesiculitis, pancreatitis, oöphoritis). It is furthermore to be distinguished from such causes of hematuria as nephritis, renal or vesical neoplasm, or tuberculosis, etc., and such causes of anuria as hysteria.

It were a waste of words to assemble in contrast here the various signs that distinguish these diseases.

Let us dwell only upon three important points, viz.:

1. The possibility of "renal" colic without stone.
2. Differentiation between stone and appendicitis.
3. Differentiation of calculous anuria.

Pseudo-renal Colic.—I have reported several cases[1] in which the passage of crystals or blood clots from the kidney, intestinal colic, and vesiculitis precisely resembled renal colic in their subjective symptoms. Biliary and appendicular colic and Dietl's crises also simulate true renal colic. Many physicians cherish the delusion that such pseu-

[1] *Trans. Am. Assoc. Gen.-Urin. Surg.*, 1906, vol. i.

do-renal colics are not as intense as the colics due to stone and do not, for example, require morphin. But in intensity there seems little choice between them. The diagnosis must be made by the X-ray and ureter catheter and with little regard for the intensity of the paroxysm.

Stone and Appendicitis.—Ureteral stone, arrested at or near the pelvic brim, is only one of many conditions which is frequently mistaken for appendicitis. Indeed, the inflamed appendix may irritate the ureter, according to Schlesinger,[1] to the extent of causing red blood cells to appear in the urine, while with stone the urine may be normal and the symptoms precisely those of appendicitis, without tumor. The X-ray establishes the diagnosis.

Diagnosis of Calculous Anuria.—Anuria may be due to many causes. The terminal anuria of nephritis (whether calculous or not) and the acute anuria of nephritis are accompanied by other grave symptoms that distinguish them plainly from calculous anuria. But hysterical anuria may be quite confusing. Thus Gordon [2] has reported a case of hysterical anuria lasting two days and cured by suggestion, while Grenier [3] saw a hysterical young woman through five attacks of anuria lasting respectively two, four, six, eight, and fifteen days. Papin [4] cites five cases to show that anuria may be the initial symptom of cancer of the rectum. The diagnosis requires radiography.

TREATMENT

Prophylactic Treatment.—Prophylactic treatment has already been discussed.

Palliative and Symptomatic Treatment.—The patient suffering from renal calculus may require palliative treatment under the following conditions:

(1) During an attack of renal colic.
(2) During an attack of calculous anuria.
(3) During a period of quiescence.

Treatment of Renal Colic.—The first thing required in renal colic is relief from pain. The patient should be placed in bed, hot-water bags placed over the painful region, and such sedatives as seem required administered. If the attack is severe, morphin should be given hypodermically with generous hand. Some comfort may be obtained, if the patient is in vigorous health, by placing him in a hot bath. The pain may be so severe as to require the administration of ether or chloroform to the obstetrical degree.

In such an emergency one may introduce the ureter catheter, hop-

[1] *Deutsche med. Wochenschr.*, 1906, xxxii, No. 44.
[2] *Med. Rec.*, 1900, lviii, 289.
[3] *Jour. de méd. de Bordeaux*, 1902, xxxiv.
[4] *Rev. de Gyn.*, 1908, xii.

ing either to push the stone back into the renal pelvis, or, by injecting olive oil, to ease its passage into the bladder; but these expedients are very rarely successful, since the stone is grasped so firmly by the ureter that the catheter cannot pass it and cannot push it upward.

Even if the colic lasts for several days, the patient may still be submitted to palliative treatment, and the opportunity may be taken to procure a radiograph and to perform ureter catheterism so as to be ready for surgical treatment if it is called for.

In the meanwhile, every drop of urine passed should be collected, so that the presence of anuria may be noted; and if anuria, whether bilateral or unilateral (as shown by the ureter catheter), is present this should be considered the main issue. In the absence of anuria, the pain may be palliated until it ceases. As the pain lessens, the patient and his attendant should be warned to watch for the stone. If the point of maximum tenderness remains stationary, it may be inferred that the stone is immobile; but if the pain and tenderness, beginning in the loin, work gradually down the abdomen and finally cease, after causing frequent and painful urination, it may be assumed that the stone has passed into the bladder, where the cystoscope will reveal it, and whence it will usually be ejected spontaneously.

Whether the stone passes or not, the surgeon should explain to his patient that other stones may be present, and should insist that a radiograph be taken at the earliest opportunity, in order to determine this point. Unless this be done, the patient is blindly exposed to all the complications of renal stone and is deprived of his safest opportunity of avoiding them.

If the radiograph shows that stones are present, after the cessation of the colic, the course of treatment is determined according to the considerations laid down below.

Treatment of Anuria.—Until within the last few years the treatment of calculous anuria has been expectant and the mortality 75 per cent (Morris). It has been the custom, and still is the practice, of many physicians, to stand by and watch the case, deluded by the absence of uremic symptoms, and misguided by an occasional spontaneous recovery, until sudden intense uremia closes the scene or summons the surgeon too late.

Such a course of action cannot be too heartily condemned. Morris states that "so useless is medicinal and expectant treatment that I have refused to attend consultations in cases of calculous anuria unless I have permission beforehand to operate at once if I think the case suitable." Such should be the attitude of every surgeon. Though the patient and his family may permit themselves to be blinded to the desperate nature of this condition by its symptomless progress, the physician cannot afford to countenance delay.

Yet, in view of the fact that calculous anuria is not likely to terminate fatally before the fourth or fifth day, and may terminate at any time in spontaneous recovery, it is advisable, during the first forty-eight hours of the attack, to attempt to dislodge the stone by administering large quantities of water, by using gin as a stimulant, and by attempting ureter catheterism. But if the anuria is not relieved on the third day, or if the patient is not seen until that time, no further palliative measures should be countenanced. Immediate operation should be insisted upon, although, if the patient's condition permits, time should be taken for radiography.

Treatment During a Period of Quiescence.—Patients known to possess renal calculi which are not causing symptoms fall into two classes:

(1) Patients who have not passed the ureteral calculus that has caused a colic.

(2) Patients whose renal calculi have remained silent in the pelvis until they have attained a great size and have caused grave pyelonephritis or pyonephrosis.

The treatment of the two conditions is different. If a ureteral calculus having caused a renal colic remains in the ureter, and radiography shows that its transverse diameter does not exceed 1 cm. or 1.5 cm., every effort should be made to encourage its passage. The patient should drink as much water as possible, and attempts may be made at oil injections through the ureter catheter, though these usually fail. Fully one half of such calculi pass spontaneously, however, and one may properly await their discharge for fully six months.

If a radiograph is taken from time to time, and shows that the stone is moving downward toward the bladder, this is, of course, an encouraging symptom, while the recurrence of colics and immobility of the stone discourage delay. Precisely how long one should wait in any given case must be decided empirically. If the stone is 2 cm. or more in width, it will probably not pass, and dangerous complications may be prevented by early operation; but if the patient with quiescent stone is of the other type, with a large stone in a suppurating kidney, while he may go for years without grave symptoms, he is, nevertheless, in a state of unstable equilibrium, carrying about within him a septic focus, the source of probable infection to the other kidney, and a deteriorating influence upon his whole economy. He may at any time fall a victim to an acute process in the kidney or to a general septicemia, and, like the patient with a smoldering appendix, he should be urged to operation. There is only one exception to this rule:

If both kidneys are full of calculi, one may well hesitate to operate, fearing that the surgical risk is greater than the risk of the disease; although, even in this instance, if ureter catheterism shows one kidney to be functionating fairly well, it is wiser to operate upon this organ and

then, after a sufficient time has elapsed to permit it to resume its function, upon the other. If both kidneys are functionating fairly well, bilateral nephrolithotomy is permissible.

Radical Treatment.—Under all other conditions except those cited above, renal calculus requires operative treatment.

The Treatment of Calculous Pyelo-nephritis.—Renal suppuration due to stone may be only one degree less benign in appearance and less malignant in reality than anuria. Suppuration caused by calculus cannot be overcome by any medical or hygienic treatment. Unless the stone can be passed off spontaneously—an outcome to the last degree improbable in suppurating cases—its growth is fostered by secondary phosphatic deposit, while the irritation it provokes in turn feeds the renal suppuration. Palliative treatment is futile except as a preparation for the knife.

Pyonephrosis and perinephritic abscess, whether calculous or not, require radical surgery.

Methods of Radical Treatment.—The radical treatment of renal and ureteral calculus consists of three operative procedures: nephrolithotomy, nephrotomy, and nephrectomy. Nephrolithotomy (pyelolithotomy or ureterolithotomy) is incision of the kidney (pelvis or ureter) for the purpose of extracting a stone. The term has been restricted to operations performed upon the aseptic kidney, to distinguish them from nephrotomy performed upon the suppurating kidney. This distinction is valuable from a surgical point of view. The term nephrolithotomy, therefore, will be employed to designate extraction of a stone from a nonsuppurating kidney, while nephrotomy, in this connection, will imply lithotomy of a suppurating organ.

Indication for Operation.—The general indication for operation is the presence of a stone too large to pass down the ureter. If the calculus is too large to pass of itself it must be removed by the surgeon. In the preceding paragraphs the modifying circumstances have been discussed —the delusive nature of the calm succeeding a renal colic, the imperative necessity for operation during anuria, the futility of delay whether the kidney is suppurating or not.

The general mortality from nephrolithotomy and ureterolithotomy does not run above 2 per cent or 4 per cent. Its discomforts are minimal. The distress so frequent after vesical, pelvic, and intestinal operations need not be anticipated, and the discomfort of lying in bed for about two weeks is almost the sum of the convalescence. Such a prospect, with its assurance of future safety, its lack of present danger, and its unimportant discomforts, outweighs a single renal colic, and is not for a moment to be compared with the progressive unsafety and discomfort to which a patient subjects himself by refusing operation.

The advantage of early operation, before the kidney becomes in-

fected, is still further enforced by the relative mortality of nephrolithotomy, nephrotomy, and nephrectomy. Nephrolithotomy—the removal of a stone from an uninflamed kidney or ureter—has, as remarked above, a mortality of 2 per cent to 4 per cent. Nephrotomy—the incision of a septic kidney—has a mortality of 20 per cent to 25 per cent, while the mortality of nephrectomy in like conditions runs from 30 per cent upward. Add to this the mortality of nephrotomy for calculous anuria (50 per cent), and the conclusion is obvious that the patient who refuses surgical relief while the kidney is yet uninflamed spurns a comparatively safe and sure cure and subjects himself to a disease which, apart from its other dangers and discomforts, may at any moment bring him to a critical condition of renal obstruction or suppuration, from which he can only escape by submitting to an operation many times more dangerous and distressing than the one he seeks to avoid.

CHAPTER XXXIX

CALCULI AND FOREIGN BODIES OF BLADDER AND URETHRA

VESICAL CALCULUS

Number and Shape.—Single calculi are generally rounded or ovoidal in shape (Figs. 76, 77, 78, 79). When a calculus is unusually elongated it is suggestive of the presence of several nuclei or of a foreign body. Calculi formed about foreign bodies are always phosphatic (Fig. 122).

Multiple calculi are usually phosphatic, less frequently urates. In general, their number bears an inverse relation to their size. When few in number they influence one another's shape and grow to be many-sided rather than rounded (Figs. 80, 81). Hence when a stone passed spontaneously presents one or more flat sides or facets, the presence of other stones in the bladder (or kidney) may be inferred.

Fig. 88.—Calculus Encysted in the Orifice of the Ureter.

Fantastic dumbbell and other shapes are assumed by encysted calculi (Fig. 88), part of the stone taking the shape of the pocket which contains it, while the remainder protrudes irregularly into the vesical cavity.

Size.—Partly on account of the infrequency of stone, partly on account of the surgeon's omnipresence, large stones are rarely seen in this day and in this country. The largest stone in my collection weighs 13 ounces. Dr. Thomas Smith [1] removed a stone weighing 24½ ounces, and Lieutenant-Colonel Bamker [2] one weighing 25 ounces. Both were phosphatic.

[1] *Lancet*, 1886, ii, 244.

[2] *Med. Record*, 1900, lviii, 637.

Spontaneous Fracture [1]

Spontaneous fracture is apparently due to long-continued dilution of the urine, which weakens the colloidal framework of the stone sufficiently to permit it to break into pieces. This rare phenomenon has been taken advantage of by the purveyors of various lithia waters. The claim that any water or drug will infallibly, or even probably, cause spontaneous fracture of stone is not based on any very good theory, and is not supported by experience. Moreover, when the calculus does break it is not to be expected that all the fragments will be expelled. One or more remain in the bladder, and around these as nuclei new stones will form. Almost all the reported cases of fracture have occurred in pure uric-acid calculi.

Symptoms

There is no symptom, no set of symptoms, absolutely and invariably pathognomonic of stone in the bladder, except the physical signs elicited by the surgeon's examination. Yet there is a certain group of symptoms which is very suggestive of stone. Chief among these are frequency of urination, pain, and hematuria, occurring by day and increased by exercise.

Frequency of Urination and Pain.—The pollakiuria and urinary pain due to stone are usually intense. They appear early in the disease and are the patient's chief complaint from beginning to end. The characteristic distress is absent during the night while the patient lies quietly on his back, and during the day so long as he is still. But every jolt induces spasm. When walking the patient moves slowly and gingerly, almost on tiptoes. Riding over a rough road or in a railroad train, or even walking downstairs, is misery. The pains are situated chiefly in the glans penis, along the pendulous urethra, and in the perineum. The desire to urinate is quite irresistible. Such is the distress, sometimes mild, sometimes severe, caused by the mere presence of the stone. As a result of some extra exertion or an acute infection, the patient, from time to time, has what is known as a *fit of the stone.* During this time his pains are greatly intensified. He may have to urinate as often as every ten or fifteen minutes day and night, so that he spends his time in one long spasm.

As the stone grows larger and the cystitis more intense these paroxysms become more and more frequent. They exhaust the patient's strength, and during them he resembles a woman in the second stage of labor. In children, prolapse of the rectum and involuntary defecation

[1] Cf. Englisch, *Archiv f. klin. Chir.*, 1905, lxxvi, and Kasamowski, *Folia Urologica*, 1909, January.

are common results of this straining; while adults complain of hemorrhoids, pass blood by the rectum, and during the paroxysms suffer from unavoidable escape of intestinal flatus and often of feces. When there is considerable prostatic hypertrophy or the stone is encysted,

Fig. 89.—Vesical Calculi. Radiograph by Dr. Caldwell.

there is less tendency to pain, so that even with intense cystitis the paroxysms may be neither frequent nor severe.

Exceptionally the pain is absent or nocturnal in the absence of prostatism. Thus my two most recent litholapaxies were performed on men, one of whom had never had any pain, though horseback riding made him bleed (Fig. 89), while the other had more pain when lying down than when sitting up. Both had large acid stones, the latter weighing 41 gm.

Hematuria.—Hematuria, like the characteristic pain, is traumatic in origin, and is, during the first stages of the disease, only aroused by some jolt. It is usually associated with pain, and the hemorrhage, though profuse, is usually short-lived. Later in the disease the perpetual straining due to cystitis may make the hematuria quite continuous.

Stoppage.—Sudden stoppage of the urinary stream is a symptom of stone which is peculiarly characteristic though not very common. It is caused by the stone rolling into the vesical orifice and plugging it like a ball-valve. Striking cases, like that of Sir Henry Thompson, whose patient could urinate only while lying on his back, are most uncommon. Prostatics with stone do not show this symptom, and it may be caused by prostatic or vesical tumor.

In children certain special symptoms are associated with stone, notably priapism and a tendency to pull at the prepuce.

Certain reflex pains in the back, testicle, etc., are among the infrequent symptoms of stone in the bladder; they are due to prostatic irritation.

Course of the Disease

Although a stone may lie quiescent in the bladder for many months, it usually excites infection before long. There may be a history of renal

Fig. 90.—Enormous Vesical Calculus in a Child. Case of Dr. Chetwood. Radiograph by Dr. MacKee.

colic or of the introduction of some foreign substance into the bladder; there may be a long history of chronic cystitis, or there may be no sugges-

tion of how the stone began. Then, after a longer or shorter time, appear the characteristic dysuria and hematuria, more or less clearly marked. Later, if there is no cystitis already, infection occurs, and leads gradually, by repeated attacks of greater frequency and intensity, to the perpetual spasm described above.

Diagnosis

Every case of painful or hemorrhagic cystitis should be examined for stone. Although the subjective symptoms just described may be absolutely characteristic, in most cases they are confused and ill-described by the patient.

Sounding or Searching for Stone.—Many different ways have been suggested to prove the existence of stone in the bladder. Among these the cystoscope and the X-ray have grown in favor of late.

The former is the instrument of choice for this examination, since through it we may expect a complete diagnosis both as to stone and as to any other condition that may be mistaken for stone (Pl. I).

Radiography is singularly inaccurate in the diagnosis of bladder stones. I have seen three cases in which they were overlooked.

If the cystoscope is not at hand, a fairly accurate diagnosis of stone may be made with the searcher. The best instrument is that of Thompson (Fig. 91). The addition of a sounding-board, a stethoscope, a microphone, or a wax covering only detracts from the simplicity of the operation.

Fig. 91.—Stone Searcher.

To *search for stone,* the patient is placed upon a table or a firm couch, lying upon his back, with the shoulders low and the pelvis raised upon a hair cushion or some other solid support, so that it may be several inches higher than the shoulders.[1] The thighs and legs are extended and lie flat. The bladder should, when possible, contain about 100 c.c. of warm boric-acid solution. The difficulty is not to recognize the stone when it is touched, but to touch it at all if the bladder is capacious; for it may elude all search when the bladder is full, and may be covered by the loose folds of the viscus and out of reach when the bladder is empty. Hence, not less than 100 nor more than 175 c.c. of fluid

[1] If the stone is movable and the bladder contains fluid, when the pelvis is raised higher than the shoulders the stone will roll away from the tender neck of the bladder and rest at the fundus behind the trigone, where it is most easily found.

should be injected. It is best not to make the examination during a fit of the stone; but if the bladder is excessively irritable or the patient is nervous—and particularly for a second search after one negative exploration—it is wiser to use general anesthesia and cystoscopy than to risk failure without it.

The searcher is introduced in the same manner as the cystoscope. When the heel of the instrument enters the bladder it should be carried gently down the inclined plane formed by the base of the bladder until arrested. Most often the stone will be struck at this point. If not, then the toe of the searcher should be gently rotated as far as it will go, first toward one and then toward the other side of the bladder. Next, the searcher is drawn forward, well inclined to one side, and by rotating the cylindrical handle gentle taps are given to the wall of the bladder along the entire side as far forward as the instrument can be drawn. It is then slid back to the fundus along the course it has just traversed. This double passage is repeated on the other side of the bladder. Next, the beak of the sound is reversed, and the floor of the bladder is swept by to-and-fro lateral motions of the tip, as it is brought forward to the vesical neck and carried back again to the fundus. If encysted or adherent stone is suspected, the fundus may be more fully examined by flexing the thighs to relax the abdominal muscles, and sweeping the bladder with the sound while counter pressure is made above the pubes.

Should a stone be touched, the bulbous tip of the searcher passed over its surface will indicate whether it is rough or smooth. The character of the click produced by tapping the stone gives a clew to its composition, a dull, low-pitched sound indicating a soft stone, probably phosphatic, while a clear, high-pitched click indicates an acid stone.

To ascertain the size of the stone, the tip of the searcher is tapped along its surface from one end to the other, and the distance traversed is estimated roughly by the length of shaft introduced or withdrawn.

The number of stones present cannot be very accurately made out. If the searcher clicks to one side and then to the other, two stones may be assumed to be present; and if at the beginning of litholapaxy a stone grasped by the lithotrite can be made to click on one or both sides, there are two or three stones present. No accurate calculation can be made beyond this except by cystoscopy or lithotomy.

The operation of sounding should always be terminated by an instillation or irrigation of nitrate of silver, and if the patient is much irritated he should be kept in bed for a day or two thereafter. The surgeon should not hesitate to desist without having reached an absolutely satisfactory conclusion, for the most skillful surgeons have failed to find stone. If the searcher alone fails the examination may be completed under general anesthesia with searcher and aspirator or cys-

toscope, in which case the patient should be prepared to undergo immediate operation if the stone is found. If he will not accept this alternative, he may be given palliative treatment, the possible presence of stone being always kept in mind, until either his improvement shows that stone is not present, or the persistence of his symptoms forces him to accept operation.

It is an essential part of the diagnosis of vesical stone to suspect and examine for renal and ureteral stone.

Prognosis

Unless the stone is small enough to be viable through the urethra, there is only one prognosis—it will certainly remain, and the symptoms will inevitably grow more severe until it is removed by operation.

Treatment

The treatment of stone in the bladder is operative. The choice of operation depends in some measure upon the patient's requirements, in some measure upon the surgeon's skill.

We need discuss only three operations—viz., litholapaxy, perineal lithotomy (or litholapaxy), and suprapubic lithotomy. Lithotrity is dead, having disappeared from surgery as its brilliant child and successor, litholapaxy, established its claims. Similarly, perineal litholapaxy has replaced the lateral operation and all other devices for extracting large stones through the perineum.

The general surgeon who interferes but rarely with the bladder cannot fail to prefer the generous drainage and clear field afforded by the suprapubic operation. On the other hand, the surgeon who has been educated in the deft maneuvers of litholapaxy will subject almost every case to that operation. If the statistics of the two operations are not identical, they are equally good in this respect at least: the surgeon who is unskilled in litholapaxy will have a higher mortality and more complications from that operation than from simple suprapubic cystotomy, while the skilled lithotritist will be able to assure his patients more rapid and comfortable cure than they could expect from lithotomy, with absolutely no danger of death in properly selected cases. In short, the situation may be summed up as follows: *Suprapubic lithotomy exposes the patient to more dangers and inconveniences than does litholapaxy. Yet lithotomy is appropriate to all cases, which litholapaxy is not; while litholapaxy requires a special training, which lithotomy does not.*

Supposing a surgeon equally skilled in all these operations, he may be expected to select his operation according to the following indications:

For children, whose urethra will take a 16 F. sound, litholapaxy; otherwise suprapubic lithotomy.

For prostatics, suprapubic lithotomy and prostatectomy in one or two stages.

For cases with grave stricture, perineal lithotomy.

For sacculated bladders, suprapubic lithotomy.

For cases requiring good drainage, such as have severe pyelo-nephritis, uncontrollable ammoniacal cystitis, or prostatic abscess, perineal or suprapubic lithotomy.

All other cases may be submitted to litholapaxy. Very large stones are, however, better cut for than crushed. I have not seen a stone so hard it could not be crushed with a Chismore percussion lithotrite, or with the ordinary lithotrite tapped by a hammer.

Results.—Lithotomy, as we have said, appeals to the general surgeon. Litholapaxy is as sure, if controlled by subsequent cystoscopy. As to mortality, we have on our office records 170 litholapaxies, without a single death in a patient under sixty years of age. Though lithotomy is extremely safe, this is safer. Moreover, the average convalescence from litholapaxy is shorter by a week and incomparably more comfortable than that from lithotomy.

Fig. 92.—Stone on Twig. Natural Size.

FOREIGN BODIES IN THE BLADDER

Besides the foreign bodies [1] which find their way into the bladder through wounds, or come down the ureters (renal calculi), a host of substances have been encountered in the bladder introduced through the urethra. All imaginable articles, such as pins, beads, stones, pieces of straw, heads of grain, glass tubing, pipe stems, pencils, portions of chalk, wax, etc., have been found in the male bladder, introduced there through the urethra under the influence of morbid erotic fancies. In this way substances of every conceivable description which the orifice of the urethra will admit are introduced into the canal and again extracted, until, on some

[1] Cf. Englisch, *Deutsche Zeitschr. f. Chir.*, 1906, lxxxix.

unlucky occasion, the object slips beyond the grasp and remains fixed in the deep urethra or the bladder. The patient's shame will often deter him from seeking relief; the foreign body may create no disturbance at first, so he flatters himself that everything is all right, until, sooner or later, perhaps long after he has forgotten his boyish folly, symptoms of stone arise, and this when removed is found to have formed upon a nucleus introduced from without (Fig. 92).

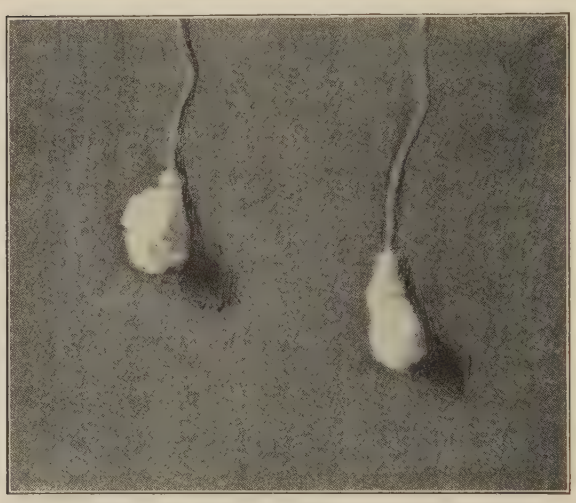

Fig. 93.—Stones Formed on Hairs of a Dermoid Cyst Ruptured into the Bladder. Natural Size.

Not infrequently, however, a foreign body comes legitimately, as it were, into the bladder; dermoid cysts containing bones, teeth, and hair (Fig. 93), may discharge into its cavity. The broken end of a catheter may constitute the foreign body, usually in cases where the individual is himself obliged to have frequent recourse to a catheter. The old-fashioned gutta-percha bougie has fallen into disfavor on account of its peculiar brittleness. Again, substances of all sorts—bone, seeds, etc.—may enter the bladder through fistulæ, while splinters, bullets, and bone may be lodged there traumatically.

The natural history of a foreign body in the bladder is that it causes some irritation, becomes surrounded with mucus, and thus becomes a nucleus for stone. In this respect blood clots, tumors, fragments of tumors, ulcers, and kidney stones act like foreign bodies, inasmuch as they may become centers of stone formation unless they are passed from the urethra.

Treatment

If the foreign body be a portion of catheter or bougie, the patient will usually hasten to tell his troubles and demand relief. If, however, it be some other foreign body, he will probably demand relief from his cystitis, all the while denying any knowledge of its cause, even after the foreign body has been extracted. When the nature of the substance in the bladder has been learned an attempt should be made at extraction, to prevent it from becoming a nucleus for stone. If there be much cys-

titis present, rest in bed, with demulcents and some anodyne, for several days before the operation, is advisable. Anything which will go into the urethra would come out again if it could be correctly seized and drawn upon in a correct line, with its point turned backward; consequently, an attempt should be made to reach all long bodies, such as pencils, and all small bodies by using a small lithorite or other forceps designed for this special purpose, of which there are several varieties kept by instrument makers. It is often exceedingly difficult to catch them correctly; soft catheters, however, are very easy to extract; they double, and may be withdrawn however caught. The difficulty in seizing a portion of soft catheter is that it cannot be felt on account of giving no click or grating against a metallic forceps; consequently, in the search for such a foreign body, the blades of the lithotrite have to be shut occasionally over different parts of the bladder surface, until the offending body is caught. Care must be exercised, of course, not to catch a fold of the bladder. The cystoscope is of assistance here and may sometimes be inserted along with the forceps. Or an operating cystoscope may be employed.

Two substances, wax and glass, demand a special notice. The former becomes so soft at the temperature of the body that not only can it not be felt, but, if seized, can only be taken away piecemeal, and some portion is pretty sure to remain behind. As to glass and other brittle substances, the danger of injuring the bladder in attempts at extraction with forceps renders all such efforts, as a rule, unadvisable. Consequently, for all foreign bodies of wax or glass, and for all such as cannot be extracted after patient effort, cystotomy should be performed, and this as early as possible, before the foreign body has had time to be incrusted with urinary salts. If for any reason the operation has to be postponed, the bladder should be washed daily.

Lohnstein, Hochenegg, and Pollak [1] have each successfully dissolved pieces of wax or tallow in the bladder by injecting some 20 c.c. of benzine and washing this out after half an hour. The injection is unirritating and may be repeated.

URETHRAL FOREIGN BODIES

Foreign bodies may enter the urethra at either extremity or may develop in and about the canal.

From without:		Fragments of surgical instruments. Substances introduced by the intoxicated, insane, or sexually perverted.
From within:		Renal or vesical calculi, or any substance which might form a nucleus for such calculi.
Originating in or about the canal.	Stone:	Formed about a foreign body, or in an ulcerated spot, pocket, or fistula. Prostatic calculus.

[1] *Wien. klin. Wochenschr.*, 1908, July 9.

Varieties.—The most varied substances are found in the urethra, introduced by the patient under the influence of that perverted and depraved sexual instinct which affects the male of all ages who gives up his mind to impure thoughts and whose sexual necessities are not gratified.

Seeds, stones, beads, beans, peas, nails, pins, needles, hairpins, slate-pencils, portions of glass, wax, cork, and a host of other substances, are thus introduced into the meatus, and, slipping beyond the reach of the fingers, are not infrequently swallowed by the urethra. Broken catheters and bougies, especially in cases of stricture, and instruments left *à demeure,* if not well fastened, may slip past the meatus and travel toward the bladder. Their constant tendency is to slip persistently onward, not because of any urethral suction or peristalsis, but merely because they are introduced blunt end first, and consequently, unless quite round, the outer end is likely to be the sharper. Therefore every erection or effort at extraction, if it move the foreign body at all, pushes it inward. Rounded bodies, such as beans or pebbles, lie in the natural pouches of the canal (fossa navicularis, bulbous urethra) or become arrested by stricture.

If foreign bodies are not removed, one of three consequences follows: 1. They travel on into the bladder and form a nucleus for stone there; or, 2. Stone forms around them in the urethra; or, 3. They cause the urethra to inflame, bring on retention of urine, and finally either become encysted or ulcerate their way out, leaving behind fistula and ultimately stricture.

Treatment.—If the body be long and soft (catheter, piece of wood), it may be transfixed with a stout needle through the floor of the urethra and the canal pushed back over it, like a glove over a finger, as far as possible, when it may be transfixed again, and so urged forward until it reaches the meatus. In manipulating with forceps, if the finger on the outside can detect and get behind the foreign body, nothing should divert the surgeon from keeping up pressure at that point in order to prevent his instrument from pushing the offending substance still deeper into the canal.

If the foreign body lies behind a stricture, the latter must be cut or rapidly dilated (continuous dilatation), to allow the passage of an instrument suitable for extraction.

Pins and needles may be extracted through the floor of the canal if their blunt ends can be steadied. To remove a hatpin its point is pushed through the urethral floor and its shaft drawn out until the head can be turned so as to extrude through the meatus.

My father once extracted a pin with Thompson's divulsor, and Dieffenbach removed one from the membranous urethra by pushing it with his finger in the rectum until the point protruded through the perineum, and then forcibly extracting it.

All other manipulations failing, perineal section will reveal the position of the object and permit extraction. The penile or the scrotal urethra should not be excised for fear of fistula in the one case, infiltration in the other.

URETHRAL CALCULUS

A stone descending from the kidney or the bladder may be caught in the prostatic, the bulbous, or the navicular urethra, or behind a stricture; or it may form about an impacted foreign body, or on any ulcerated spot or fistula. It assumes the shape of that part of the canal or cavity in which it lies.

Urethral calculus is usually a urinary calculus arrested in the urethra. Less often it forms *in situ*—e. g., about a foreign body or behind a stricture. Prostatic calculi are mentioned below.

Englisch [1] has collected 113 cases of calculi in the prostatic urethra, 149 in the membranous canal, 68 in the bulb, 103 in the penile and scrotal regions, and 41 in the fossa navicularis.

The calculi are elongated in shape, faceted if numerous, and if neglected grow to considerable size and form pouches in which they lie.

Symptoms.—If the calculus comes from the bladder the onset of symptoms is sudden. As it enters the urethra during urination the flow stops suddenly, while a sharp pain is felt. A second effort may extrude it from the canal or only impact it more firmly, or it may fall back into the bladder and remain a vesical calculus. Once impacted, it may cause complete retention, or, more commonly, dysuria.

If, on the other hand, the stone forms *in situ,* the onset of symptoms is insidious. First, there is slight gleet and some difficulty in urination. The gleet becomes slowly worse, and finally periurethritis occurs, which goes on to extensive suppuration and fistulization. The obstruction to urination is not complete.

Periurethral calculi may remain latent for a long time, until they obtrude upon the lumen of the urethra or excite suppuration in the pocket within which they lie.

Diagnosis.—A sharp attack of urethral colic is unmistakable, but the less acute conditions just described simulate stricture of the urethra; indeed, stricture and stone often coexist. The mistake is not a vital one, however, for any attempt at dilatation will produce a grating sound characteristic of stone, and the calculus may be felt between the instrument and the finger externally.

Treatment.—In acute cases an attempt may be made to push the stone back into the bladder if it has not passed the membranous urethra;

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[1] *Archiv f. klin. Chir.*, 1904, lxxii, 487; *Centralbl. f. Harn, u. Sex. Org.*, 1904, xv, 18, 81, 135.

or, if it has passed, the anterior urethra may be distended with olive oil and the stone worked forward to the meatus, whence it may be extracted by crushing or by meatotomy. These failing, the meatus may be pinched and the patient encouraged to urinate; when the canal is fully distended the meatus is released and the stone expelled by the gush of urine. The urethral lithotrite is a dangerous instrument and of doubtful utility. The scoops and forceps of Collin and Leroy d'Etiolle, though ingenious, are never at hand at the right moment. When these methods fail external urethrotomy succeeds.

Chronic cases of urethral calculus call for external urethrotomy to remove the stone, to excise the pocket in which it lies, and to divide or excise the stricture which is usually present.

Infiltration, abscess, and fistula are considered in Chapter XXIV.

PROSTATIC CALCULUS

Prostatic stones or calculi are, properly speaking, urinary calculi which have become lodged in the prostatic urethra or in the prostate itself. Prostatic concretions are the result of a concentration of the prostatic secretion, and originate in the gland itself. These are very common in the prostates of middle-aged men. They are formed of phosphatic salts and epithelial detritus. They rarely attain the size of a pea, and, unless they exceed this size, have no clinical significance. They may attain any size and shape. Several may be found separated from one another, perhaps embedded in dilated follicles, or, if many are present, they cause atrophy of the prostatic substance, until the prostate resembles a sack full of small stones, which may be felt rubbing against one another on pressure *per rectum,* giving an emphysematouslike crackling (Adams). In bad cases prostatic calculi tend to unite, projecting into the urethra, and forming curiously distorted, branched masses, dipping down into the substance of the prostate, and extending forward into the canal of the urethra, and backward perhaps into the bladder. Such masses have been found 4 or 5 inches long. One, removed by T. Herbert Barker, was composed of 20 portions, weighing, collectively, 3 ounces, 4 drams, and 1 grain—about 110 grams.

PREPUTIAL CALCULUS

These resemble urethral calculi in that they may descend from above or be formed *in situ,* and have been exhaustively studied by Englisch.[1] They are extremely rare.

[1] *Wien. med. Presse,* 1903, No. 47–49.

CHAPTER XL

GENITO-URINARY TUBERCULOSIS

In the clinic, tuberculosis is often spoken of as though it were confined to the genital or urinary organs, just as at other times, as though confined to the lungs, the joints, or other parts of the body; yet tuberculosis is always a systemic disease, and it is impossible during life to be sure of the precise distribution of the tubercular lesions. Even though the tuberculosis may apparently be confined to certain organs, and even though cure of the tuberculosis in these organs may be followed by complete and permanent relief from all symptoms of tuberculosis, we can never be sure during the patient's life that there is not some other focus of the disease in the body which may give symptoms at some future time. Postmortem observations almost invariably show that, when there is tuberculosis of the genital or urinary organs, there are lesions in the lungs or in the lymph nodes somewhere else in the body.

The Onset of Genito-urinary Tuberculosis.—The symptoms of genito-urinary tuberculosis usually show themselves first either in the bladder or in the testicle; but the appearance of symptoms is entirely fallacious, and we shall see that tuberculosis may be said never to begin in the bladder. Saxtorph (quoted by Watson) reports one case of primary tuberculosis in the bladder. Fenwick has reported similar cases.

It is my personal opinion that tuberculosis is very rarely primary in the epididymis, though we frequently see cases in which the epididymis is the only organ apparently diseased; but, waiving this personal opinion for a moment, we may accept the findings of Walker [1] as sufficiently accurate. Walker collected 279 cases of genito-urinary tuberculosis, in 184 of which the kidney was the first organ attacked, in 80 the epididymis, in 6 the prostate, in 6 the Fallopian tubes, in 2 the seminal vesicles, and in 1 the uterus. The renal pelvis and ureter are never attacked primarily. From these various organs the disease may spread to any of the other organs of the genito-urinary tract.

In the genital and in the urinary tract it is customary to speak of ascending or descending invasion, or extension of tuberculosis. In the urinary tract, descending extension means that the disease begins in the

[1] *Annals of Surgery*, 1907, xlv, 249, 388, 597.

kidneys and extends thence to the bladder or to the genital tract, through the blood current or through the ureter. Ascending extension is in the opposite direction, from the bladder to the kidney. Similarly, in the genital tract, descending infection is (usually) taken to mean extension from the epididymis to the testicles or prostate, ascending infection the opposite.

The French school, following Hallé and Motz [1] and Albarran,[2] maintain that, since no one has ever found ureteral tuberculosis without renal tuberculosis, we have no right to assert that ascending invasion of the kidney from the bladder ever occurs. They maintain that all urinary tuberculosis is descending tuberculosis. Inasmuch, however, as tuberculosis always begins in one kidney, just as it always begins in one epididymis, and is usually very slow to attack the opposite kidney, instances of bilateral renal tuberculosis are seen in which it seems probable that infection of the second kidney is due to vesical retention, and may just as properly be attributed to ascending invasion as may any simple pyogenic renal infection.

Yet it is equally true of pyogenic nephritis and tubercular nephritis that, although clinically ascending and due to retention, the actual process may well be that the kidney is congested or dilated by retention, but infected by bacteria circulating in the blood. Retention certainly prepares the kidney for infection; but whether the bacteria reach the kidney from the general blood stream or by traveling against the urinary stream or in the lymphatics (the existence of which is asserted by Moullin and denied by Walker), we do not know.

Rovsing, at the First International Urological Congress, combated Albarran's views and cited certain cases as evidence of ascending renal tuberculosis, and although the question is certainly not yet settled, we may accept it as a general proposition that, clinically speaking, tuberculosis of the urinary organs begins in the kidney and descends thence to the bladder; while infection of the opposite kidney may be clinically ascending, inasmuch as it is unlikely to occur until grave lesions of the bladder and urethral retention shall have prepared the way for what is currently termed ascending infection.

In the genital organs conditions are not quite the same, since there is no retention to damage the second epididymis. Yet the tuberculosis often travels from one epididymis to the other within one or two years, and, in many instances, without notable or characteristic lesions of the intervening prostate and vesicles.

Extension of Lesions from the Genital to the Urinary Tract.—The spreading of tuberculosis from the urinary tract to the genital tract,

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[1] *Guyon's Annales*, 1906, xxiv, 161–241.

[2] *Transactions of the First Internat. Urological Congress*, 1908.

or from the genital to the urinary tract, is not thoroughly explained, but we recognize clinically that the disease often spreads from one tract to the other. It is probable that the prostate forms the point of juncture.

Tuberculosis of the kidney, reaching to the bladder, may spread thence to the prostate and thence to the epididymis; but when tuberculosis begins clinically in the epididymis and spreads thence to the prostate and to the bladder, it is probable that invasion of the kidney is due to hematogenous infection, although it may be encouraged by retention from tubercular infiltration about the neck of the bladder.

Frequency of Tuberculosis of the Different Parts of the Urinary Tract.—Given the above facts in reference to the onset and extension of tuberculosis of the genito-urinary organs, it is obviously futile to attempt statistical tabulation of the distribution of the disease. The number and variety of organs involved will depend upon the period at which the patient is seen. It has been my clinical experience, in examining the records of 100 patients with tuberculosis of the epididymis,[1] to note that in 26 cases the epididymis was apparently the only organ involved. In 24, other organs of the genito-urinary system were involved, and in 31 there were either evidences or history of tuberculosis elsewhere in the body outside of the genito-urinary tract.

Mixed Infection.—Mixed infection occurs early in urinary tuberculosis, so that one practically never removes a kidney that does not show evidence of mixed infection, and one rarely looks into a tuberculous bladder that does not show a more or less generalized cystitis, probably due to mixed infection. Indeed, the active progress and symptoms of the disease are in large measure due to this secondary, pyogenic infection. Yet, in certain instances, only the bacillus of tuberculosis is isolated from the urine. In the epididymis, mixed infection is not so constant, though it is frequent either at the onset of the tuberculosis or as a later complication.

Etiology.—Tuberculosis is, generally speaking, a disease of youth, and genito-urinary tuberculosis is no exception to this rule. Thus, in 65 per cent of cases observed by me, tuberculosis of the epididymis has appeared between the ages of fifteen and thirty-four, yet 28 per cent appeared between the ages of thirty-five and forty-nine; but the cases in which the genital deposit appeared relatively late in life had almost all shown earlier lesions elsewhere in the body, so that, of my series, 71 per cent showed tuberculosis somewhere in the body between the ages of fifteen and thirty-four.[2]

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[1] *Annals of Surgery*, June, 1907.

[2] The onset of renal tuberculosis can be identified with far less accuracy since it may remain latent for a considerable period.

Trauma.—A few cases have been cited as evidence of renal tuberculosis following injury. Yet such cases are very rare. The trauma of stone has not, so far as I know, ever been alleged as a cause of renal tuberculosis. The stones found in tubercular kidneys are secondary. Trauma is equally rare as a cause of epididymal tuberculosis. Only 6 per cent of my cases gave such a history.

Gonorrhea.—Gonorrhea has not been alleged as an important cause of renal tuberculosis, though it is looked upon as a frequent cause of prostatic or epididymal tuberculosis. I certainly have not found it such. In only 11 per cent of my cases was the patient known to have gonorrhea, either acute or chronic, at the time of onset, while 19 per cent denied ever having had the disease at all, and of 4 cases with quiescent epididymal tuberculosis whom I saw through attacks of gonorrhea, 2 had acute exacerbations and 2 did not.

Coitus.—There is no sufficient evidence of tubercular inoculation of the genital or urinary organs in coitus.

CHAPTER XLI

TUBERCULOSIS OF THE KIDNEY

PATHOLOGY

THREE types of tubercular inflammation of the kidneys are recognized. These, with their subdivisions, are as follows:

General miliary tuberculosis.
Surgical tuberculosis.
  Parenchymatous.
  Papillary.
  Pelvic.
Toxic tubercular nephritis.

General Miliary Tuberculosis.—Miliary tuberculosis of the kidney occurs as part of a general miliary tuberculosis disseminated throughout the various viscera. It has no interest for the surgeon.

Surgical Tuberculosis.—Surgical tuberculosis begins with one or more localized tubercular deposits in one kidney. While it is possible that both kidneys may be attacked simultaneously, this is doubtless as rare as for both epididymes to be attacked simultaneously. It seems probable that but one kidney is attacked by tuberculosis at first, and its fellow is usually involved only after a number of years have elapsed.

Parenchymatous Lesions.—The initial lesion of surgical tuberculosis usually appears in the renal parenchyma, and almost invariably at one or the other pole. The central portion of the kidney is usually the last to be attacked by tuberculosis.

The lesion begins as one or more discrete infiltrations of round cells. These coalesce and necrose, forming at first hard nodules and later cheesy masses surrounded by infiltrated areas, which increase in size with greater or less rapidity (Fig. 94).

Old tubercular foci become cheesy cavities surrounded by areas of infiltration and interstitial sclerosis, extending, perhaps, for a considerable distance throughout the kidney parenchyma. If the tubercular process is still active, these sclerotic areas may be studded with little tubercles in process of formation. The tuberculosis thus spreads throughout the kidney by direct extension, or by the appearance at a distance of new localized foci. By the time the tubercles attain the size

of a large pea, they are likely to reach the sinus of the kidney and to break into the pelvis, discharging their contents and thereafter forming deep tuberculous ulcerations and infecting the neighboring portions of the pelvis; or else, by discharge of tubercle bacilli in the urine, infecting various portions of the ureter and of the lower urinary tract by direct urinary contamination (Figs. 94, 95, 96). Less often and, as a rule, less early, the tubercles rupture through the capsule of the kidney, causing tubercular perinephritic abscess.

FIG. 94.—RENAL TUBERCULOSIS. Upper pole a mass of tubercular tissue; lower pole pyonephrotic; pelvis obliterated.

Papillary Tuberculosis.—In this very rare form of renal tuberculosis the tubercle is situated at the tip of one of the renal papillæ. It promptly ulcerates into the pelvis and apparently shows little tendency toward general dissemination throughout the organ. Hurry Fenwick and Israel were the first to describe this lesion.

Pelvic Tuberculosis.—The precise frequency of tuberculosis of the pelvis at the onset of renal tuberculosis is not definitely known. Ware has removed a kidney showing tubercular granulations upon the inside of the pelvis at a very early stage. These are little, discrete, rounded, velvety areas. As seen at a later stage by the surgeon, however, pelvic tuberculosis usually consists of a considerable thickening of the wall of the pelvis, with ulceration upon its inner surface, with no tendency to perforation, but with marked sclerosis of the cellular and fatty tissue about the pelvis. As a result of these secondary changes, the cavity of the pelvis may be almost obliterated, causing renal retention and dilatation.

Secondary Sclerotic Changes.—The secondary sclerotic changes about an old tubercular focus of the kidney have been described. The remaining nontubercular parenchyma may be the seat of a toxic parenchymatous tubercular nephritis (see below). The fatty capsule of the kidney undergoes marked sclerotic changes over the tuberculous areas

and to a less degree over other parts of the kidney. Marked perirenal fibrolipoma sometimes occurs. The infiltration about the pelvis of the kidney has been alluded to above.

Secondary Pyogenic Changes.—Mixed infection usually supervenes soon after a tubercular focus ruptures into the pelvis. The mixed infection is usually mild, and does not excite acute suppuration in the kidney, even though blocking of the pelvis dilates the organ into a pyonephrotic sac; but mixed infection in a tubercular lesion, rupturing through the capsule into the perinephritic space, may result in acute suppurative perinephritis.

Extension of the Disease.—The disease extends directly to the ureter and to the bladder, probably by inoculation from the tuberculous urine.

The Ureter.—The ureter may be attacked by tuberculosis in any part or throughout, but the favorite sites of infection are its upper and lower extremities. At the upper extremity, the ureter may become ulcerated and stenosed, though not infrequently it is merely thickened and

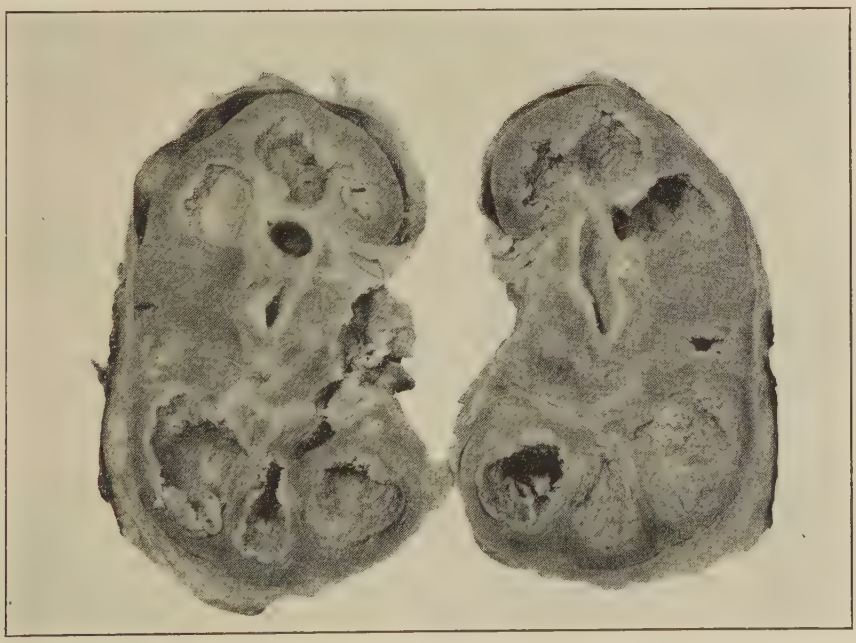

Fig. 95. — Renal Tuberculosis. Abscesses throughout, but chiefly at poles; fibrolipomatous and suppurating perinephritis; ureter obliterated.

dilated (Fig. 96). At the lower extremity it becomes infiltrated, ulcerated, dilated, or contracted, showing the characteristic tubercular-ureter appearance to the cystoscope (Pl. I).

In old cases, the ureter may be involved from end to end, and this

involvement shows itself as an irregular thickening and thinning with ulceration, irregular dilatation, points of stricture, and a general peri-urethral sclerosis, while to the cystoscope it shows a distortion of the trigone caused by the pulling upon it of the shortened ureter.

FIG. 96.—Renal Tuberculosis. Abscesses at upper (T) and lower poles with renal tissue (R) between. Pelvis obliterated; ureter (U) thickened and dilated.

The Bladder.—Involvement of the bladder usually begins about the ureter orifice and progresses in the manner described in the next chapter.

Toxic Tubercular Nephritis.—The kidneys of a patient suffering from any grave tubercular lesion, or from any other form of chronic sepsis, become the seat of chronic parenchymatous toxic nephritis, a process caused by the incessant poisoning of these organs from the toxic products they are eliminating. Therefore, if one kidney is gravely affected with surgical tuberculosis, its fellow and, indeed, its own uninvolved parenchyma, become the seat of this "medical" toxic

nephritis. The existence of this lesion is, of course, of the greatest importance in determining the prognosis for the patient in case of nephrectomy.

The Opposite Kidney.—In early surgical tuberculosis of the kidney the opposite kidney is normal. By the time the patient's symptoms have acquired sufficient severity for him to consult a physician, the disease is almost always unilateral; but before the physician has made his diagnosis, or before the patient's symptoms have become sufficiently severe for him to consult a specialist, the opposite kidney has become invaded by the surgical tubercular process in about 10 per cent of cases.

SYMPTOMS

The mere presence of a tubercular focus in the kidney gives no symptoms whatever. If such a focus bursts into the pelvis it is likely to cause a sharp, brief hemorrhage, and thereafter the patient suffers painful and frequent urination, this painful and frequent urination being probably due, in some measure, at least, to the passage of infected urine into the bladder, though the bladder itself is not at this stage of the disease infected. Ureteral and vesical inoculation soon occur, however, and add to the intensity of the vesical irritation.

Later in the disease renal symptoms appear. If the sclerosis about the pelvis and upper end of the ureter (or in any part of that channel) leads to renal retention, the pain and fever of infected hydronephrosis or pyonephrosis appear; while if the tubercular focus irrupts into the perinephritic tissue, the local pain and doughy tumor of perinephritic abscess supervene. It is, however, characteristic of renal tuberculosis that, except for an onset which may or may not be marked by hematuria and renal colic, it is likely to continue for months or years without any renal symptoms whatever, but with only the classical painful and frequent urination and pyuria commonly attributed to cystitis.

The duration of the disease is quite indefinite. It is equally true of all tubercular lesions that some run a virulently rapid course, while others are extremely slow to progress. The two cases of renal tuberculosis that I have watched longest each date back for fourteen years. One of them has recently undergone a successful nephrectomy at my hands; the other has refused nephrectomy, and for several years past has had no symptoms whatever of his disease excepting the presence of pus in his urine.

We may now briefly consider the characteristics of the chief symptoms of urinary tuberculosis.

Hematuria.—The initial hematuria occurs in a large proportion of cases, but may be so slight and brief as to be overlooked. Even if severe, it is not likely to last more than a day or so, and its spontaneous disap-

pearance misleads the physician into believing that the danger, which is only just beginning, has passed.

The bleeding of tuberculosis may recur at any time. It is not particularly characteristic. It is not severe, like that of neoplasm, nor associated constantly and markedly with pain, as that of stone.

A considerable interval usually elapses after the primary hemorrhage before bleeding recurs, but in the later stages of the disease, with mixed infection, the purulent urine is likely from time to time to show a little blood. Violent hemorrhage is rare, though the bleeding from an ulcerated papilla may be so severe as to endanger life.

Painful and Frequent Urination.—This is, as we have seen, an early symptom of renal tuberculosis which usually continues throughout the disease, but may cease if the tubercular kidney becomes a closed pyonephrosis. The frequency is spontaneous by day as well as by night. The patient may urinate as often as every hour or so, even when the bladder is uninvolved; and when the bladder becomes tuberculous the frequency is often extremely great.

The pain occurs during the urinary act and at its termination. Terminal spasm is most severe if the bladder neck is ulcerated, but may occur even when there are no lesions of the bladder whatever. If due chiefly to bladder lesions, the pain and frequency may be ameliorated by local treatment; but if due to pus coming from the tubercular kidney they cannot, of course, be affected by any treatment of the bladder.

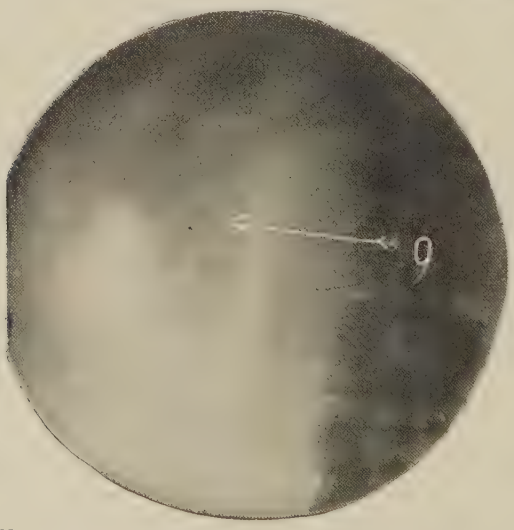

Fig. 97.—Radiograph of Tubercular Pyonephrosis (O). (By Dr. Cole.)

Renal Pain and Tumor. — These symptoms are, as we have seen, of late occurrence in renal tuberculosis. Inasmuch as a tubercular seminal vesicle may give pain in the loin, it is possible for the pain to be felt in the opposite loin from that in which the tubercular kidney lies. This actually occurred in the case depicted in Fig. 97.

Renal colic from the passage of clots of blood or shreds of caseous matter is exceptional.

The kidney rarely enlarges sufficiently to form a very large tumor, even when it is pyonephrotic. The pyonephrotic tubercular kidney is,

however, usually painful and sensitive to pressure, but a marked tumor in the loin usually indicates perinephritis.

General Characteristics.—The patient may or may not present the general characteristic of tuberculosis, a history of previous personal or family tuberculosis, or evidences of the disease elsewhere in the body. Israel states that there was the usual tubercular evening rise of temperature in only 22 per cent of his cases of uncomplicated renal tuberculosis, though 80 per cent of those whose bladders were involved had fever. The loss of weight may or may not be marked, and it has been my experience that the pulse is habitually rapid.

DIAGNOSIS

The diagnosis of tubercular kidney in its early stages is extremely difficult. It is, indeed, impossible to make an early diagnosis of renal tuberculosis without the cystoscope and the ureter catheter. The diagnosis must cover the following points:

(1) The presence of urinary tuberculosis; (2) the region of this tuberculosis, whether in the prostate or in the kidney; (3) if in the kidney, which kidney is involved; (4) if one kidney is involved, what is the condition of its fellow?

The means of diagnosis are, in the order of their employment:

Urinary signs.
Physical signs.
Tuberculin tests.
Cystoscopy and ureter catheterism.

Urinary Signs.—The characteristic urine of tuberculosis is acid and purulent. It contains the tubercle bacilli and perhaps other bacteria. A low percentage of urea and high percentage of albumin, and the presence of casts are suggestive of severe toxic nephritis of the opposite kidney.

Acidity.—The acidity of the urine descending from a tubercular kidney is not excessive, but this urine is always acid unless there is marked mixed infection with ammoniogenic cocci. Such a mixed infection is very unusual.

Pyuria.—Until mixed infection occurs, the urine from a tubercular kidney contains little pus; but if the mixed infection is slight, there may be quite a definite pyuria with very slight bacteriuria. Indeed, an acid urine containing pus, the microscopic examination of which reveals no bacteria whatever, is very suggestive of tuberculosis. The ulceration constantly exudes at least a few red-blood cells in the urine.

The Tubercle Bacillus.—The tubercle bacillus in the urine, as elsewhere, is an acid-fast bacillus 2 μ or 3 μ long. It is likely to occur in groups with some tendency to arrangement in chains and in S-shapes.

These characteristics, however, are not always sufficient to differentiate it from the smegma bacillus, which may occur in normal urine (Pl. II, Fig. 3).

The smegma bacillus, which is closely related to, if not identical with, the so-called Lustgarten bacillus of syphilis, occurs in and about the normal preputial cavity (and in other regions outside the genitals). It has not infrequently been found in the urethra, and Sondern has even found it in the urine obtained by the ureter catheter (Pl. II, Fig. 4).

Young and Churchman,[1] after an extensive review of the literature and original experimental observations, conclude "that it may be impossible, in cases with organisms in the urine resembling the tubercle bacillus in morphology and stain, to eliminate the diagnosis of tuberculosis by any clinical feature. It may be impossible to eliminate such a diagnosis by cystoscopic examination. It is impossible to distinguish positively in every case between the tubercle and smegma bacillus by any method of staining now known. The confusion in diagnosis cannot surely be avoided by catheterization. Animal inoculation is a tedious method, and this is sufficient to condemn it if an equally sure method can be provided in its place. It may, of course, be necessary when *no* red-staining organisms can be found. Cultures are unsatisfactory because of the uncertainty of the smegma bacillus to grow, and of the difficulties of growing either organism. The method is a slow one. It is likely to be unsuccessful because of contaminating overgrowth; and even when cultures have not failed, we may be thrown back on staining or tedious inoculation methods to identify the organism."

These authors suggest that a thorough irrigation of the urethra (with a quart of boric-acid solution), and thorough cleansing of the glans and meatus, suffice to clear away the smegma bacillus. The patient then passes his urine in three glasses. The specimen of urine to be examined is taken from the third glass, centrifuged for at least five minutes, and stained by Gabbet's method. ("Heat specimen in carbol-fuchsin, wash off in water, decolorize, and counterstain with Gabbet's solution of methylene-blue, sulphuric acid, and water.")

Yet even this test is of doubtful efficacy. The characteristic depended upon by most authors consists in the clumping of tubercle bacilli in the characteristic forms described above. Smegma bacilli are rarely found in the urine except as separate individuals, and extremely rarely in clumps. Yet the most eminent pathologists have been known to confuse smegma bacilli with the bacilli of tuberculosis, in spite of all these precautions.

The only absolute test is inoculation, and even inoculation may be inconclusive, since the pig may die of mixed infection long before the

[1] Johns Hopkins Hospital Reports, 1906, vol. xiii, p. 15.

weeks have elapsed which are required for a positive diagnosis of tuberculous infection. Fortunately, however, the discovery of the tubercle bacillus in the urine is usually only one of the many tests for urinary tuberculosis.

Physical Signs.—Spontaneous pyuria without urethral retention is almost invariably caused by either tuberculosis or stone. The physical diagnosis should be undertaken with the purpose of eliminating one or the other of these maladies, though it must not be forgotten that the two may exist together. Physical diagnosis may also disclose the region of the tuberculosis.

Palpation of the loin may reveal nothing. If the kidney is plainly palpable, it is probably not tubercular; if it is only sensitive, it may or may not be tubercular; if there is perinephritis, it may or may not be tubercular. Palpation of the prostate, the seminal vesicles, and epididymes may reveal tubercular lesions in these organs. Palpation of the vaginal vault in the female may reveal a thickened ureter traversing it, but this ureter is not necessarily tubercular. The tubercular ureter has been felt by abdominal palpation but rarely.

The patient's body should be examined for scars of tubercular lymph nodes or evidences of ancient joint or bone disease; his lungs should be carefully examined for evidences of tuberculosis; his heart for the hypertrophy suggestive of toxic nephritis; his pulse for the rapidity and tension which suggest the same condition, but may be due to nervous overtension; his temperature for the evening rise.

Tuberculin Tests.—The familiar injection tuberculin test has been but little employed in the diagnosis of urinary tuberculosis because of the possibility of excessive reactions which may excite an acute exacerbation of the lesions.

Of the newer tuberculin tests, the Calmette conjunctival reaction is too dangerous to the eye, and the von Pirquet vaccination test is not over-accurate in adults.

I habitually employ the Moro reaction. This consists of rubbing into the skin a 50-per-cent mixture of tuberculin and lanolin. The skin is prepared by washing with soap, alcohol, and sterile water, and a minute bit of the ointment is thoroughly rubbed into the skin for at least five minutes. The skin is then protected with a sterilized dressing. The reaction usually appears in three days, sometimes not for six days. It is characterized by a general erythema of the area that has been rubbed, with a thick outcrop of little papules which sometimes vesiculate. Temperature reaction is extremely rare. The erythema is reported to have appeared, in some cases, not only over the place rubbed, but over a symmetrical area on the opposite side of the body. The eruption fades in the course of a week or two. It is not constant, yet it is as reliable as any of the tuberculin tests, but it only shows that the patient has tuber-

culosis somewhere in the body. Thus I obtained a positive reaction in a young man with a small, ulcerated lesion near the left ureter, but the lesion was successfully excised and proved to be a papilloma with no evidences of tuberculosis. Yet a residence of three months in the mountains immediately after the operation caused the patient to gain ten pounds over his previous weight, thereby confirming the diagnosis of tuberculosis; but the tuberculosis was not in the urinary organs.

Cystoscopy.—The cystoscope may show tubercular lesions scattered over the bladder (p. 466) and may reveal whether the primary lesion is in the kidney or the prostate. If in the prostate, the chief site of tuberculosis is about the bladder neck; if in the kidney, it is about the mouth of the corresponding ureter. But even though the kidney be gravely diseased, the bladder and ureter may show no changes (Pl. I). The characteristic lesions of the tubercular ureter are inflammation, ulceration, and retraction (Pl. I).

The Inflamed Ureter Mouth.—The ureter may simply be swollen and edematous, or it may be dilated or golf-holed like the ureter of non-tuberculous pyelo-nephritis (p. 379).

Ulceration of the Ureter Mouth.—The lip of the ureter or the adjoining region may be the seat of rounded or irregular-shaped, shallow ulcerations with sharp red edges and a sloughing base. Such ulcerations are peculiarly suggestive of tuberculosis. If the ulceration is marked, the actual orifice of the ureter may be lost in the midst of the crater-like ulcer.

In other instances the ulcer is a velvety granulating surface. In either event there is usually simple cystitis of the remainder of the trigone and perhaps of other portions of the bladder.

Retraction of the Ureter Mouth.—If a considerable portion of the ureter is thickened by tuberculosis, the canal may be shortened and the trigone thereby dragged to one side, so that by turning the cystoscope to appreciate the relative position of the two ureter mouths, we may find the normal ureter dragged almost or quite to the median line, while the ureter from the diseased kidney is far off to the side. If this ureter mouth is not markedly ulcerated, a definite retraction may be noted in it; instead of projecting from the surface of the mucous membrane, it is drawn into the bottom of a funnel.

Inactivity of the Ureter Mouth.—Although the ureter mouth may be quite normal itself, careful observation of its contractions may show these to be sluggish or absent, but this sign is an unsafe one to depend upon.

Ureter Catheterism.—If the physical conditions permit, the diagnosis of urinary tuberculosis should always include ureter catheterism. If only one ureter is catheterized, it is safer to catheterize the normal

one. If catheterism is impossible, the Luys segregator may be employed.

Catheterism or segregation are all but essential to the final diagnosis. Nephrectomy of a tubercular kidney should not be attempted without them. If possible, the phloridzin or the indigo-carmin test should be employed, and Albarran's experimental polyuria.

The tubercular kidney may be polyuric at the onset of the disease, but it is slow in elimination and gives a relatively poor polyuria curve.

Operation may be most urgently required in a case that cannot either be catheterized or segregated; but the local signs are so vague and misleading that one is likely to fall into the error of operating upon the wrong kidney or of operating upon a kidney whose fellow is so diseased that it cannot support life.

Early phloridzin elimination in the total urine is not absolute proof that one of the kidneys is sound, nor is delayed elimination evidence that one of the kidneys cannot support life. I have successfully removed a tubercular kidney from a patient who eliminated no phloridzin for two hours, and Israel and several others have had a like experience.

PROGNOSIS

The prognosis of tuberculosis of the kidneys depends upon the nature of the lesion, the age of the patient, and the presence of lesions elsewhere in the body. Unfortunately, the nature of the lesion cannot be precisely determined until the kidney is out. The age of the patient has an indirect bearing upon the prognosis, for tuberculosis of the kidney, like that of other organs, assumes a more malignant form in the young and advances more slowly in later years. Finally, distribution of the disease among other organs of the body, and especially in the other kidney, has a marked influence on the prognosis.

Albarran states that tuberculosis of the kidney is never spontaneously cured. It may become and remain latent for an indefinite period, but it always remains as a focus of potential activity.

TREATMENT

The treatment of renal tuberculosis is almost purely surgical. Inasmuch as the lesion is almost always complicated by mixed pyogenic infection at the time the patient is first examined, little can be expected from hygienic treatment. Indeed, those few patients whose tubercular renal lesions become encapsulated and latent are by no means those who are best able to take care of themselves. The one patient in whom I have noted the existence of symptoms from a tubercular kidney has scarcely had any vacation from his occupation as a painter in New York

City. Even though this encapsulation occurs, the physician can never feel sure, so long as the patient lives, that an outbreak of the tubercular lesion will not occur either in the kidney or elsewhere in the body. The gravity of this doubt is impressed upon us by the unexpected failure of some of our most promising cases, for tuberculosis of the urinary tract is no less treacherous a disease than that of the respiratory tract. In some cases it is chronic and advances but slowly; in others, it is frightfully malignant, and we have as yet no absolute criterion by which to distinguish the two classes. Even the operative treatment of tuberculosis of the kidney must be recognized as palliative only; that is to say, the surgeon may chance to control the disease by extirpating the kidney; but extirpation of the kidney does not extirpate the tuberculosis. It only removes the active focus of the disease, and thereby gives the patient a better opportunity for overcoming the disease existing less actively in his other organs. Yet the great success that has attended nephrectomy for tuberculosis and the absolute failure that attends the palliative treatment make nephrectomy the only treatment for surgical tuberculosis of the kidney.

Tuberculin inoculation is of little value, though it may control symptoms temporarily. I have had no success with it.

Indications for Nephrectomy.—If there is tuberculosis of one kidney, that kidney should be removed. The only contra-indication is the existence of tuberculous lesions elsewhere in the body of such gravity as to prohibit the operation. Such prohibiting lesions may, for example, exist in the lung and be of such severity as to prohibit any capital operation; or the opposite kidney may be so gravely affected as not to be capable of supporting life.

In estimating the capacity of the opposite kidney to support life, the functional diagnosis, as detailed in a previous chapter, is of the greatest assistance, and I believe that a good polyuria curve is the best evidence of a sufficient function in the opposite kidney. Yet, as we have seen, none of the functional tests are positive, and the patient's general condition should be given great weight in making the decision. If the general condition is good, and the functional tests show that one kidney is *much* more gravely affected than its fellow, this kidney should be removed. The existence of slight tubercular lesions in its fellow is no contra-indication to the operation; but if the general condition is bad, slight impairment of function in the relatively normal kidney should have great weight as a contra-indication to operation.

Lesions of the bladder and of other portions of the other urinary and genital organs are no contra-indications to nephrectomy.

In performing nephrectomy, the tubercular ureter may be disregarded. Many cases have shown that Kapsammer is wrong in stating that tubercular lesions of the ureter and bladder do not heal after re-

moval of the tubercular kidney. If the patient's general condition is bad, the function of the opposite kidney only moderately good, and the gravely diseased kidney either pyonephrotic or surrounded by perinephritic abscess, the suppurating focus may be drained as a preliminary measure and the patient submitted to hygienic treatment until his general condition shall have improved sufficiently to permit nephrectomy, which may then be performed as a secondary operation.

CHAPTER XLII

TUBERCULOUS AND SIMPLE ULCERATION OF THE BLADDER—TUBERCULOSIS OF THE PROSTATE AND SEMINAL VESICLES

TUBERCULOSIS OF THE BLADDER

Etiology

Tuberculosis of the bladder is probably always secondary to lesions in the kidney or in the prostate, though Fenwick [1] has reported cases of tuberculosis of the bladder that seem to be primary.

Pathology

Distribution of Lesions.—The lesions of vesical tuberculosis begin about the ureter if the disease descends from the kidney; about the bladder neck if the invasion is from the prostate; but when the case is first cystoscoped, there is often a general distribution of the lesions about the trigone, and perhaps about the rest of the bladder, which prevents a definite diagnosis from cystoscopy alone, without the aid of ureter catheterization.

If there is mixed infection, the whole bladder may be inflamed. If not, even though the greater part of the organ is inflamed, there are usually regions in which the normal mucous membrane may be seen at some parts of the vault of the bladder.

The tubercles appear as minute whitish areas, the size of a pinhead, surrounded by an area of congestion. They are usually grouped together over irregular areas of the bladder wall, while between them the mucous membrane is red, swollen, and velvety. Thus a diffuse vesical tuberculosis gives the whole mucous membrane a velvety appearance. Although the tubercles may be seen, and sometimes even felt, through the unbroken epithelium, the initial deposit occurs, as Coplin [2] has justly remarked, not in the epithelium, but in the subepithelial connective tissue.

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[1] "Ulceration of the Bladder," London, 1900.

[2] *Jour. of Cut. and Gen.-Urin. Dis.*, 1898, xvi, 557.

The tubercular ulcer "is singularly round and discoid. . . . Even the confluent ulcers rapidly lose the isthmus which at one time partly separated them and quickly assume a roundish outline. The floor of the ulcer is shaggy, of a dirty yellowish color. It is uneven in contour. . . . Commonly the ulcer does not become larger than 1 or 2 cm., or about the size of a 5-cent piece. The floor of the ulcer is the submucosa containing considerable embryonic tissue. In some instances and at a few points in any ulcer the muscular wall may be exposed. . . . I think extension into the muscular wall must be rather infrequent. . . . The edges are elevated and slightly undermined . . . hard to the touch" (Coplin).

The above description, written from the point of view of the pathologist, is entirely in accord with the clinical findings. I have never known perforation of the bladder to occur, though I have followed many cases for years. Senn,[1] however, makes a point of the danger of perforation. Coplin suggests that perforation, which he believes very exceptional, may be due to mixed infection. The great irritability of the bladder—its characteristic inability to retain more than a few ounces—is due at first to the great sensitiveness of the tubercular lesions, later to an actual infiltration and contracture of the muscular walls—a sort of concentric hypertrophy.

The distribution of the lesions may be irregular, but the center of trouble is always in the trigone or about the mouths of the ureters. Thence the tubercles, ulcers, and congestion spread slowly to all parts of the organ by lymphatic extension, by direct growth and coalition of the ulcerated tubercles, and perhaps by contact, an ulcer of one surface giving rise to a secondary ulcer on the opposite surface by actual contact with the mucous membrane.

In the more acute forms of the disease the tubercles, the ulcers, and the lesions of simple cystitis are variously combined. But in the commoner chronic cases the disease assumes one of two forms. If the infection comes from one kidney the bladder lesions are entirely confined to the neighborhood of the corresponding ureteral orifice. Ulcerations and tubercles are closely grouped around this point as a center. If, on the other hand, the disease begins in the prostate, the neck of the bladder bears the brunt of the inflammation. The mucous membrane here becomes congested, thickened, and ulcerated until the condition is almost an exact counterpart of a simple contracture of the neck of the bladder. In perineal section, with cutting down of the contractured orifice, I have sometimes been unable to detect any difference between the simple and the tubercular inflammation.

Direct examination of the inflammation from or to the posterior ure-

[1] "Tuberculosis of the Genito-Urinary Organs," 1898, p. 188.

thra is common. Extension to the anterior urethra is rare. I have seen it but once.

Symptoms

Vesical tuberculosis is simply a specialized inflammation of the bladder with characteristics so little distinct that many of the most pathognomonic among them have been determined only within the last twenty years. The course of the disease is varied and often obscure. Sometimes the symptoms are quite characteristic, but the final diagnostic test rests always with cystoscopy and the discovery of the tubercle bacillus.

Onset.—The disease, beginning usually during the course of a renal or prostatic tuberculosis or of a chronic gleet, declares itself first by one of two symptoms, hematuria or irritability of the bladder. This onset may be spontaneous or provoked by the use of instruments in the urethra. Whether bleeding or irritability comes first, the other soon follows.

Hematuria.—The hematuria of tuberculosis is usually quite characteristic. It is a prominent symptom of the disease first and last. It differs from the hematuria of stone in being influenced little, if at all, by jolting or exercise, and it is only in exceptional cases a free hemorrhage, such as is common from neoplasm. The first bleeding noticed by the patient is often the exudation of a few drops of pure blood at the end of the urinary act. The blood is squeezed, as it were, from the base and neck of the bladder by its own contraction. This *terminal hematuria* is usually accompanied by some terminal pain and spasm and is strongly suggestive of tuberculosis, though it may occur with any severe congestion about the neck of the bladder. The next urine passed is usually red with blood, and so the bleeding continues for a few hours or days, and then apparently stops, to recur after an interval of days or weeks. In the meanwhile, however, the urine is not entirely clear of blood. Though not a bright red, it may still be smoky, and even when clean and sparkling the microscope will almost invariably detect a few red blood cells in a centrifuged specimen, and a trace of albumin will also be found. So these bleedings recur, never profuse enough to fill the bladder with clots, growing perhaps more, perhaps less, frequent, but never stopping entirely. They occur by night as well as by day; they are uninfluenced by exercise or by rest. As the disease progresses and its lesions spread the hemorrhages become, if anything, less profuse and more continuous. The urine gets to be hazy all the time, and contains few clots. The last few drops passed may be pure blood, but beyond this there is not likely to be any severe bleeding except after the introduction of instruments into the bladder.

Irritability of the Bladder.—The characteristic irritability of the bladder—the frequency of urination and the pain accompanying the act—

is often the earliest and always the most distressing symptom of tuberculosis. At first, the frequency of urination is not great, and the pain is chiefly confined to the end of urination. As the bladder contracts down on the last drops of urine, as the terminal hematuria appears (if there is terminal hematuria), a sharp pain is felt in the perineum and often on the under surface of the penis at the peno-scrotal angle. Pain may also be felt in the glans penis and may radiate in various directions. The effect of this pain is to excite a tighter spasm of the bladder, and the result of this spasm is an increase in the pain, so that pain and spasm persist after the last drop of urine has been expelled, leaving a soreness which may not pass off before another urinary act renews the wretched cycle. At first this terminal pain is not constant, but later it accompanies every act of urination and grows more severe as the disease progresses.

After a short time, when ulcers have formed, or a mixed infection has occurred, another pain is felt, a pain before urinating, often an imperious and irresistible spasm which, if not immediately acceded to, will squirt a few drops of urine down the sufferer's thigh in spite of all his efforts to prevent it. The increased sensibility to pressure brings on some such spasm, more or less severe, as soon as a few ounces have entered the bladder; and what with this spasm before urinating and the more intense spasm afterwards, what with the constantly decreasing capacity of the bladder and the increasing frequency of urination, the patient knows no peace day or night. The irritability of the bladder is even more strongly marked when instrumentation is attempted. Such are the bleeding and spasm aroused by almost any instrument or wash that the patient soon learns to dread these with all his soul. A special antipathy of the tubercular bladder to nitrate of silver distinguishes tuberculosis from simple cystitis.

The Urine.—The urine of tubercular cystitis is acid. At first it may be cloudy or bloody. Later it is bloody, and often foul with the products of a suppurative cystitis ingrafted on the tubercular process either spontaneously or as the result of catheterization. But, however foul and malodorous, however full of shreds of bloody mucus and stringy clots the urine may be, its one striking characteristic is its continued acidity. It is by no means impossible for the urine of a mixed infection to be alkaline when passed as a result of the predominance of pyogenic cocci; but, clinically, alkaline urine is most exceptional in tuberculosis, however violent the mixed infection. This persistent acidity, in face of the odor and the foul muco-pus so characteristic of alkaline cystitis, is one of the most suggestive features of the disease.

Chemical analysis of the urine usually reveals albumin in considerable quantity derived from the red blood cells, or perhaps in part from the kidney.

The microscope shows pus, red blood cells, and bladder epithelium. A diligent search for casts must be made, for, if found, they suggest the existence of a renal lesion, presumably tubercular.

The Tubercle Bacillus.—The most important part of the urinary examination is the search for the tubercle bacillus (p. 459).

Other Symptoms.—Among the other symptoms due to tubercular cystitis a partial incontinence of urine from spasm or from ulceration of the neck of the bladder is notable. Mixed infection adds to the pyuria and phosphatic stone may be formed and multiply the patient's agonies. The symptoms of involvement of the other genito-urinary organs are, sooner or later, important, and the rapid pulse, hectic fever, and general deterioration characteristic of this disease may be distinguished in advanced cases.

Diagnosis

Familiarity with the symptom-complex just laid down, together with the discovery of tubercular lesions elsewhere in the body, may be depended upon to establish the diagnosis in many cases. A family history of tuberculosis may also be elicited.

Method of Examination.—In the examination of a patient with tubercular cystitis the nature of the disease may be first suspected from the symptoms, the history, or the evidence of tuberculosis in the testicles, prostate, or lungs, or from the general tubercular aspect of the patient. If this is the case, every effort should be made to relieve the bladder irritability as much as possible before undertaking cystoscopy. But, sooner or later, *cystoscopy is required by every tubercular bladder to determine the condition of the kidneys.* This rule holds good whether the prostate is involved or not. General anesthesia may be required.

Urinary examination and detection of the tubercle bacillus are always part of the routine examination.

Differential Diagnosis.—The evident features about the disease, early or late, are bleeding and irritability. It may be confused with simple cystitis, stone, tumor, contracture of the neck of the bladder, and renal tuberculosis. From *simple cystitis* it is distinguished by the preponderance of hemorrhage and irritability, by the special antipathy of the tubercular bladder to nitrate of silver, by the evidence of tuberculosis elsewhere in the body, and by the discovery of the tubercle bacillus in the urine. *Stone in the bladder* often gives rise to symptoms closely resembling tuberculosis; the cystoscope establishes the diagnosis. *Tumor* is not often confused with tuberculosis, but excessive irritability from the former, or excessive hemorrhage from the latter, may make they seem very much akin. *Contracture of the neck of the bladder may* as we have seen, be either simple or tubercular. The symptoms of the two resemble each other so closely that one of our best-known genito-uri-

nary surgeons habitually confounds them. Cystoscopy, or the discovery of the tubercle bacillus in the urine, is absolutely essential to convict anyone with a contracted vesical neck of being tubercular. *Renal tuberculosis* often gives symptoms purely referable to the bladder (p. 456).

Prognosis

The course of the disease is irregular and slow. The symptoms grow worse year by year; but the disease may last a long time—I know of one man who is no worse now than he was twenty years ago, though he has had a violent tuberculosis of the bladder all that time—since it is not in itself fatal, though it may well render life unendurable. When death occurs this is due to renal or pulmonary involvement, and upon the implication of these vital organs depends the prognosis. Recovery is possible, though extremely rare. But the symptoms are often readily controlled.

Treatment

Conservative treatment of tuberculosis of the bladder has given far better results than any of the radical procedures that have been employed. It must be the surgeon's aim to let the bladder entirely alone, if possible, and to confine his treatment to the climatic, hygienic, dietetic, and tonic treatment appropriate to tuberculosis of any organ. Whatever local or operative treatment has to be undertaken, hygiene is always the backbone of treatment. Among tonics, cod-liver oil, creosote, and guaiacol hold their accustomed places. I have had good results from ichthyol and ichthalbin administered internally. Balsamics and alkalies may be employed to modify the urine and to soothe the bladder. Urinary antiseptics are useless and likely to prove irritating.

Tuberculin injection may relieve the symptoms, but it does not appear to cure.

Local Treatment.—In the early stages of the disease local treatment is absolutely contra-indicated. It only irritates the bladder and provokes ulceration of the tubercles.

When the disease is well advanced some treatment is usually necessary to control the vesical spasm. Local treatment is employed for this purpose, often with great success, but only according to certain well-defined rules. In the first place, gentleness is more essential here than in any other form of urinary disease. In the second place, irrigations must not be used. They are very badly borne by the sensitive bladder and do no more good than instillations. In the third place, nitrate of silver, boric acid, and permanganate of potash, so soothing to simple cystitis, cannot be employed in tubercular cystitis on account of the violent reaction they provoke even in very weak solution—this is es-

pecially true of the silver salts. Finally, the best rule for local treatment is to use the drug that gives the most comfort, regardless of any curative powers it may possess.

I have frequently achieved almost miraculous results by instillations of corrosive sublimate. These may be administered daily, 2 to 10 minims to a dose, in very weak solution. Beginning with 1:25,000, the strength of the solution is increased as far and as rapidly as the patient's symptoms permit. The treatment should excite no sharp reaction.

Collin employs the following:

℞	Pulv. iodoform	1 gm.
	Guaiacol	5 "
	Ol. oliv. steril.	100 "

Chetwood has used 25-per-cent to 100-per-cent solutions of guaiacol valerianate in olive oil, and 3-per-cent to 12-per-cent watery solutions of thallin sulphate. Both Senn and Horwitz suggest trichlorid of iodin in 0.2-per-cent to 0.5-per-cent solution, and the former also employs the familiar 10-per-cent iodoform-glycerin emulsion. Cumston has employed lactic acid (5 per cent), Rovsing carbolic. Gomenol is well spoken of.

Of all these remedies, the ones I have found most soothing are sublimate, guaiacol valerianate, and thallin. Of these, the former two are the more healing, but one is forced to use thallin when nothing else gives relief. The instillations should be repeated two or three times a week.

Operative Treatment.—Hygiene and local treatment may fail—they often do. The indications for operation are: 1. To relieve symptoms by establishing continuous drainage and so allowing the bladder to rest. 2. To cure the disease by topical applications. 3. To remove the diseased tissue by cautery, curette, or knife. The last indication can seldom be acted upon. It is not possible to remove all the diseased tissue, since the primary focus is usually in some adjacent organ and the oldest bladder lesions are about the trigone, where they can least well be excised. Moreover, an operative failure entails dire results. The patient may be relieved of his dysuria, but he is condemned to a permanent tubercular fistula. If the operation has been performed as a last resort, with this permanent fistulization in view, the patient may well be content to put up with it; but if he finds himself, without any warning, condemned for life to a foul fistula, a leg urinal, and a filthy bed, his gratitude to the surgeon will be slight indeed. Hence, early operation is not indicated; there is too much to lose and too little chance of gain. It is generally conceded that operation is required only when local treatment has failed completely and the patient is unable to support his

agony. Then the prospects may be clearly set before him: the slight chance of permanent cure, the possibility, the advantages, and the disadvantages of permanent fistula. If the patient is willing to risk everything on the chance of improving his condition, the surgeon may then proceed with a clear conscience to do what he can.

The selection of operation must be left to the surgeon's judgment. If the patient is far gone with renal or pulmonary disease a simple suprapubic cystotomy, with permanent drainage, will give the best results. Extirpation of the whole mucous membrane has even been resorted to (Delagénière [1]), while such lesser operations as excision of an ulcer or cutting down the neck of the bladder are frequently performed. The results have been unalluring. In a few cases the excision of tubercular ulcerations has effected a cure, but in most the vesical tuberculosis has relapsed and the spread of the disease in other organs has been unchecked. Any interference with a tubercular vesical neck is likely to result most disastrously in permanent incontinence, and perhaps in permanent tubercular perineal fistula. Dr. Chetwood has obtained rather more encouraging results with his perineal galvano-cauterization, but the method is as yet experimental in this respect.

On the other hand, excellent results have been obtained by medication of the bladder through the suprapubic wound. The bladder may be irrigated daily with the iodoform, guaiacol, or sublimate solutions described above. The result is usually disappointing, yet such treatment may alleviate the symptoms and effect a cure.

SIMPLE ULCER OF THE BLADDER

There are five kinds of vesical ulcers:

1. **Tubercular Ulcers.**
2. **Malignant Ulcers.**
3. **Inflammatory Ulcerations.**—These have no clinical significance. They consist of exfoliations and superficial exulcerations of the mucous membrane occurring in the course of an acute or a chronic cystitis.
4. **Traumatic Ulcers.**—These result from stone or are postpartum complications. The bladder wall having been crushed during parturitions by forceps or by the child's head, a part or all of it may slough away.[2]
5. **Simple Ulcers.**—These ulcers, known also as idiopathic, embolic, and perforating ulcers, are very rare. Bartleet,[3] Wyeth,[4] and

[1] *Guyon's Annales*, 1896, xiv, 59.
[2] O'Neil, *Trans. Am. Assoc. Gen.-Urin. Surg.*, 1909, vol. iv.
[3] *Lancet*, 1876, i, 210.
[4] *N. Y. Med. Jour.*, 1892, lv, 582.

Johnston [1] have reported cases, and Guterbock [2] mentions the subject; but Hurry Fenwick [3] has considered it most intimately. While confessing the extreme infrequency of the condition, and admitting that it can only be distinguished from tubercular ulceration by the absence of tubercle bacilli from the urine (a perilous criterion), the absence of any other evidence of tubercular disease, and the ultimate recovery of the patient (though a tubercular ulcer may heal spontaneously), he maintains, nevertheless, that the simple ulcer of the bladder is a distinct clinical entity. "There is usually only one ulcer. . . . Its size rarely exceeds that of a shilling, and its situation is nearly always to the inner side of the ureteric orifice. . . . It usually affects the tissues of the posterior wall and does not actually encroach upon the trigone." Fenwick compares this ulcer to the simple ulcer of the stomach, and mentions one case of perforation.

The *symptoms* are comparable to those of tuberculosis; but the pains are alleviated by all forms of irrigation, instead of being made worse. The *prognosis* is good. A *cure* may be effected by curetting.

TUBERCULOSIS OF THE PROSTATE

Tuberculosis of the prostate is the central point, as it were, of genito-urinary tuberculosis. Whether or not the prostate is the site of the original lesion of genital tuberculosis, it is through the prostate that tuberculosis of the urinary tract reaches the genitals, and *vice versa,* and it is through tuberculosis of the prostate that the inflammation crosses from one testicle to the other.

Etiology

Those who consider tuberculosis of the prostate a primary lesion find its chief cause in chronic gonorrheal prostatitis. Sexual excess, calculus, etc., have been incriminated, and in some cases the disease has evidently nothing to do with previous inflammation. Like other tubercular manifestations, it is commonest in the young adult of a tubercular predisposition. I cannot accept infection *in coitu.*

Pathology

Tuberculization always begins just beneath the glandular epithelium. It goes through the ordinary stages of caseation, abscess formation, and fistulization, or it may terminate by cicatrization.

Although the tubercular prostate may show no lesions palpable by

[1] *Brit. Med. Jour.,* 1893, i, 1003.

[2] "Die Krankheiten der Harnblase," 1890, p. 375.

[3] *Brit. Med. Jour.,* 1896, i, 1133; also "Ulceration of the Bladder," London, 1900.

rectal touch, the disease is usually bilateral, rarely or only for a brief space confined to one half of the gland.

When abscess forms it usually bursts into the urethra. I have known but three to open posteriorly. After rupture the tuberculosis spreads to the posterior urethra and bladder.

Symptoms

The disease begins in one of four ways:

1. It is secondary to a chronic posterior urethritis, assuming its specific characteristics imperceptibly, and patient and surgeon are often unaware of the change until rudely aroused by some of the typical manifestations of tubercle.

2. It is apparently spontaneous. The patient comes complaining of gleet or dysuria for which he fails to account.

3. It is a minor feature of an epididymal infection. The patient complains of the enlarged testicle, and is not aware of the shreds or pus in his urine that testify to the prostatic inflammation.

4. Less frequently a spontaneous hematuria or a urethrorrhagia is the first sign of the disease.

The prostate may be tubercular for many years and yet give no symptom. When symptoms arise they are due to ulceration of the posterior urethra and bladder neck and are precisely those of tubercular cystitis.

Diagnosis

The diagnosis of tuberculosis of the prostate before rupture is usually uncertain.

After the bladder has become involved rectal touch and the cystoscope determine whether the disease arises from the prostate. But the mere discovery of indurations in and about the prostate does not prove that the original and important focus is not in the silent kidney.

Prognosis and Treatment

Until invasion of the urethra gives rise to symptoms the prognosis is excellent (for tuberculosis). Many cases never give a symptom.

After rupture the prognosis is that of vesical tuberculosis.

Treatment is the same as for vesical tuberculosis.

VESICULAR TUBERCULOSIS

Tuberculosis of the vesicle is always at first unilateral. Before both vesicles are affected the prostate must become inflamed. Whether tuberculosis is usually primary in the prostate or in the vesicle is not clear.

The lesions of localized tuberculosis—tuberculization, caseation, and suppuration terminating in fistula or atrophy—appear first near the mouth of the organ, where they may remain localized or whence they may be disseminated throughout its length.

Symptoms

Commonly there are no symptoms directly referable to the vesicle. Hemospermia, abscess, fistula, increase or decrease in the sexual appetite —all these are rare. In most cases there is simply evidence of a tuberculosis of the prostate or of the epididymis, and examination reveals the condition of the vesicle. Simmonds [1] examined 25 cases of tubercular vesiculitis post mortem and only 6 of these were found to be sterile.

Diagnosis

When the prostate or epididymis is known to be tubercular and the vesicle is found dilated or tender it may be assumed to be tubercular as well.

On the other hand, when there is doubt as to the nature of the prostatic inflammation an examination of the vesicles may sometimes throw some light upon the subject. If typical hard nodular areas of tuberculariza tion are encountered they at once establish a diagnosis. But more often the organ is merely dilated in a manner suggestive of simple inflammation. If, in such a case, the urinary and physical examinations fail to indicate the nature of the disease, the latter may declare itself in a characteristic but disagreeable fashion by an outburst of tubercular epididymitis directly referable to the examination of the vesicle. Hence the rule: *never massage or examine a suspected tubercular vesicle except with the lightest possible touch.*

Treatment

All local treatment of a palliative sort must be studiously avoided. Massage and douching do not benefit the vesicle, but endanger the testicle. Here, as elsewhere, the general hygienic treatment of tuberculosis is of prime importance.

It is but recently that the vesicle has come fairly within the reach of the scalpel, and many vesicles are sacrificed to celebrate this new triumph of surgery. The circumscribed lesions of tuberculosis have proved especially tempting. Even those who believe that the disease is primary in the testicle or epididymis may feel justified in extirpating the vesicle, either when known to be diseased, or in all cases, as a routine

[1] *Deutsch. Archiv f. klin. Med.*, 1898, lxi, 412.

precaution. I am not ready to accept either alternative. Of the large number of cases in which the vesicle is known to be tubercular, only the smallest percentage shows grave symptoms of this lesion. Whether the vesicular inflammation be primary or not it is usually amenable to hygienic treatment. Yet exceptional cases with extensive caseation, suppuration, or fistulization, demand vesiculectomy, and to these it should be accorded, but to no others.

CHAPTER XLIII

TUBERCULOSIS OF THE EPIDIDYMIS AND TESTICLE

Tuberculosis affects the testicle in two ways:

1. Diffuse miliary tuberculosis, associated with general miliary tuberculosis, and of no interest to the surgeon.

2. Circumscribed tuberculosis, which concerns us here. This form of tubercle appears as localized deposits, one or more, beginning in the epididymis, and involving the testicle only secondarily.

ETIOLOGY

The *predisposing causes* of epididymal tuberculosis are three: 1. The tubercular diathesis. 2. The existence of a focus of tuberculosis elsewhere in the body. 3. Local trauma or inflammation (precedent or persistent).

Although the profession is by no means agreed in the matter, it has been my personal experience that, when there is tuberculosis in the testicle, tubercular lesions may invariably be discovered elsewhere in the body, the patient almost always has tubercular antecedents, and there is often some local disturbance to determine the localization of the tuberculosis.

The *efficient cause* is the tubercle bacillus.

Pathogenesis.—There are three theories concerning the genesis of genital tuberculosis:

1. That it is primary in the prostate or the seminal vesicles whence the epididymis is invaded secondarily, the inflammation extending along the vas, or, possibly, by way of the lymphatics (Kocher,[1] Lanceraux,[2] Guyon [3]).

2. That genital tuberculosis is primary in the epididymis, secondary in the prostate and seminal vesicles (Réclus,[4] Senn,[5] Councilman [6]).

3. That the tuberculosis, whether occurring primarily in the one

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[1] *Op. cit.*, p. 326.
[2] *Guyon's Annales*, 1883, i, 153.
[3] *Ibid.*, 1891, ix, 445.
[4] "Du tubercule du testicule," Paris, 1876.
[5] "Tuberculosis of the Gen.-Urin. Organs," 1897, p. 48.
[6] Dennis's "Surgery," 1895, i, 246.

end of the seminal canals or in the other, may be due to inoculation during coitus (Verneuil, Jacobson,[1] Paladino-Blandini [2]).

Two questions, therefore, arise: Can the inoculation take place during coitus? Is the epididymis invaded primarily or secondarily?

As to infection during coitus, no one holds that such infection is at all frequent. The question is whether or not it ever occurs. Tubercle bacilli have been found in the healthy epididymis (Jani and Weigert [3]), and Paladino-Blandini has apparently shown that all bacteria, tubercle bacilli among others, when deposited on the mucous membrane of the urethra near the meatus may reach the epididymis, but cause no inflammation there under ordinary conditions. Yet these experiments, though very interesting as showing that immobile bacteria can travel against the current, and thus giving experimental evidence of the propagation of disease along the vas, prove only that infection in coitus is barely possible, for the combination of circumstances postulated—viz., a massive urethral inoculation and a trauma to the testicle—would be, clinically, hard to find. Inoculation *per urethram* is, to say the least, improbable.

Is the epididymis invaded primarily or secondarily? The highest authorities are divided on this point, and perhaps this division is founded on a diversity of cases, some primary, some secondary. There is no question here of the primary focus in the body, but only of the primary focus in the genital tract. Is it in the epididymis, or is it in the prostate and vesicle? I cannot answer the question except by an array of facts, all of which seem to point toward the same conclusion: 1. I have examined the urine of every case of tubercular epididymis that I have seen in the last ten years, and in no case have I failed to find in the urine either shreds or pus indicative of a prostatic congestion, though there be no discharge whatever at the meatus. 2. I have often seen tubercular prostatitis and vesiculitis without any lesion of the epididymis. 3. When, one epididymis being already involved, the other one becomes implicated, I am confident that a tubercular prostate forms the bridge from one side to the other, and therefore the second epididymis, at least, is not involved primarily.

To sum up: with a tubercular epididymis the prostate is never normal (though I confess that its congestion may possibly be similar to that seen about the mouth of the ureter in tubercular kidney) and is sometimes manifestly tubercular to rectal touch. On the other hand, with a tubercular prostate or vesicle the epididymis is not necessarily involved. Involvement of the prostate precedes involvement of the second testicle. The migration of the bacteria in sufficient numbers to

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[1] *Op. cit.*, p. 323. [2] *Guyon's Annales*, 1900, xviii, 1009.
[3] *Virchow's Archiv*, 1886, ciii, 522.

cause damage is rendered intelligible by Paladino-Blandini's experiments, referred to above, which, while they do not reproduce the conditions requisite for infection in coitus, do represent with sufficient accuracy the conditions of so-called ascending inflammation. All the weight of this evidence goes to show that, in many, if not in all, cases, the prostate or vesicle is tubercular before the epididymis becomes so.

The *age* at which tubercular inflammation is most common is between twenty and thirty. Fully half the cases occur between these years, and the disease is very rare before fifteen and after fifty.

By reason of its more sluggish circulation the left testicle is more often affected than the right.

PATHOLOGY

Authorities differ as to whether the epithelium or the intertubular tissues of the *epididymis* are first involved, and on these differences build a support to their views upon the primary and secondary nature of the

Fig. 98.—Specimens Obtained by Orchidectomy and Epididymectomy for Tuberculosis. The epididymes (laterally) are tubercular throughout; on right side was much enlarged; on left normal. Testis (center) split, showing tubercles.

disease. Suffice it to know that the primary tubercles conglomerate to form the hard masses so typical of beginning tuberculosis. These go on usually to caseation, suppuration, and fistulization, or else cicatrize or calcify.

The Vas.—The vas is often lumpy with tubercular deposits, distended by the products of inflammation, and often involved in a periderferentitis throughout its length. When present this thickened, knobby

vas is one of the characteristic features of the disease. The *vesicle* and *prostate* may be clinically tubercular.

The Testicle.—The testicle is often encroached upon by a tuberculoma or by an abscess. Though primary tuberculosis of this organ is rare, examinations by various authors of testes obtained by castration

Fig. 99.—Section of Tubercular Testicle.
A group of tubercles invading the healthy tissue.

have almost always shown a more or less widely disseminated beginning tuberculosis of this gland. This discovery has been hailed as startling proof of the advantage of total castration, it being very justly urged that the lesions in the testicle would be overlooked by the surgeon intent upon some conservative operation. It is true, however, that these lesions of the testicle are often present in cases treated by conservative operations, as well as in those not treated surgically, and that in most instances the testicle is able to overcome the infection if given an opportunity, although the occasional appearance of purely orchitic abscesses

after epididymectomy is evidence that the enemy is not always repelled.

The Vaginalis.—The tunica vaginalis may be studded with tubercles, producing chronic hydrocele. Operation always reveals hydrocele.

The Urinary Organs.—The urinary organs are often affected with the genital organs. Such cases form a picture of complete genito-urinary tuberculosis. Either the urinary or the genital tuberculosis may be primary (p. 449).

The Lungs.—The lungs are often enough spared. Thus Kocher, among 451 autopsies on cases of urogenital tuberculosis, found as many as 95 (21 per cent) with normal lungs. During life the pulmonary involvement is often insignificant. On the other hand, Réclus found, among 500 phthisical patients, 64 with genito-urinary tuberculosis, 45 with involvement of the genital tract, and 19 with tubercular testes only.

SYMPTOMS

The patient, a young man often with tubercular antecedents, comes complaining that one testicle is larger than the other. The swelling may have been spontaneous or it may have followed injury, or perhaps a previous gonorrheal epididymitis never got quite well and now has begun to swell again. Questioning may disclose a family or a personal history of tuberculosis, or an account of frequent and painful urination perhaps slight, previous, or still existing. The epididymal lesion is usually tender, rarely painful.

Less often the onset is acute. The testicle is greatly swollen and hard. There is considerable pain, and the vaginalis rapidly fills. This condition may subside, leaving a few nodules here and there, or it may go on to suppuration.

Upon examining such a testicle it is usually found somewhat enlarged throughout, with large, hard nodules at one end or the other of the epididymis, or throughout its length. There may be lumps in front in the testicle itself. The outline of the tumors may be obscured by fluid in the tunica vaginalis. The vas deferens may be knotty, enlarged, and hard, as far as it can be felt, and a finger in the rectum may detect the seminal vesicle similarly affected. Nodules may perhaps also be detected in the prostate and vesicles; the urine contains prostatic shreds and pus in small or large quantity, and there are, perhaps, symptoms referable to tuberculosis of prostate, bladder, or kidney. The lungs, too, may be involved. Until suppuration occurs the testicle is almost painless, testicular sensation is not materially reduced, and the opposite testicle is not usually affected. Sexual power and desire are influenced only by the fears of the patient.

The malady advances slowly, sometimes remaining stationary for

many months; finally, the nodules soften into abscess, the skin adheres, and the abscess bursts and discharges a thick, cheesy material. These abscesses remain fistulous for a long time, sometimes indefinitely. New abscesses tend to form, pointing by old or by new routes. After abscess of the substance of the testis, hernia testis may come on. When the disease invades the scrotum the inguinal glands enlarge. Such a condition is often mistaken for cancer. A patient may have both testicles indurated, knotted, full of fistulæ for years, and still seem to enjoy excellent health; but usually he is pale, thin, anemic, weak, perhaps with tubercular deposits in his lungs or elsewhere.

COURSE AND PROGNOSIS

The usual course of the disease has been described above. It is that of a local malady advancing slowly to a fatal termination. When, however, the patient's surroundings are unfavorable and his general health poor, he may succumb rapidly to the local disease. Indeed, we occasionally meet with a case which starts like an ordinary acute epididymitis, the *tuberculose galopante du testicule* of Duplay, and never remits its fury. In other cases the chronic course of the disease is interrupted by acute exacerbations.

The cases [1] may be divided into two classes: (1) those in which the epididymal lesion is the chief active tubercular lesion in the body (26 cases), and (2) those in which the tubercular lesion is only a part—perhaps a relatively unimportant part—of genito-urinary (24 cases) or general (31 cases) tuberculosis; but no patient remains hard and fast in either class. The clinical picture varies as one or another lesion rises into prominence. One may follow clinically, however, and with some degree of order, the course of the lesion in the epididymis itself (where it may be acute or chronic, suppurating or quiescent) and in its fellow.

The acute onset, as well as the acute exacerbations during the course of the disease, are probably due to mixed infection. Caseation and fistula may, however, occur without any mixed infection.

Such breaking down, whether acute or chronic, simple or tubercular, occurred in at least 76 of the 152 testicles, probably in a great many more. It is a striking fact, however, that of these 76 cases of softening or suppuration, 53 occurred in the first year, while late suppuration was noted only once in the third, fourth, and fifth year respectively.

It would seem, therefore, that if the process remains chronic in the epididymis for a year or two, it is not very likely to break down. I have seen the nodule become swollen and threatening to break down in

[1] This and some of the following paragraphs are quoted from my report of a hundred cases of tubercular epididymitis in the *Annals of Surgery*, June, 1907.

later years; but it has always either settled back into its chronic condition or been removed before softening took place.

On the other hand, no suppuration occurred in 29 cases watched for more than one year. Fourteen of these were followed less than four years, 9 from four to nine years, and 6 respectively ten, eleven (2 cases), twelve (2 cases), and sixteen years.

Condition of the Opposite Testicle.—Here is perhaps the most important point of all. Many patients permit one testicle to be removed in the hope that the disease is confined to this one organ, and may be amputated. This hope is utterly vain, and relapse upon the opposite side almost inevitably occurs, be the operation ever so slight or ever so radical.

This is proven by the summary of the 87 cases in which it is definitely recorded that the opposite epididymis was or was not affected. Fifty-three so relapsed; 34 had not done so when last seen.

Involvement of the opposite epididymis occurred within the first two years in 46 cases. In only 3 did this occur after the third year, though 10 others remained unilateral for longer periods.

I have followed for more than a year 35 cases that did not suppurate and 34 that did (1 duplicate). Of the suppurating cases, 18 were still active when last seen, 2 of them within three years, 2 four, 3 five, and 1 six years. Sixteen either burst or were incised, suppurating for a certain number of months thereafter, and then were seemingly cured. Three such apparent cures were followed but one year; 1 for two years; 1 for four; 1 for five (bilateral); 1 for six; 1 for seven; 1 for eight; 2 for ten (1 bilateral); 1 for twelve (bilateral); 1 for thirteen [1]; 1 for twenty-five (bilateral); 1 for twenty-seven years. Yet, to prove that, no matter how long these patients remain well they are not absolutely guaranteed against relapse; in 1 case suppuration followed gonorrhea fourteen years after the apparent healing.

That 30 per cent of cures, watched for more than three years, should follow suppuration in the tubercular testis is most surprising, and I fear would not be verified if the cases were more numerous. Yet, on the other hand, those cases which did not suppurate were forever smoldering or advancing. Single cases showed irregular activity as late as five, six, eight, and ten years after the onset; while apparent cures were observed at five, eight, nine, twelve,[1] and sixteen years—only 14 per cent.

Mortality.—I can record no mortality from tubercular testicle. One patient died of phthisis (six months), 1 of tubercular meningitis (six years), and 1 of pelvic abscess after operation (six years); but none of these deaths is directly attributable to the testicle.

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[1] Opposite epididymes of one patient.

DIAGNOSIS

The three conditions with which the tubercular testicle is likely to be confused are simple epididymitis, syphilis, and neoplasm. The means for distinguishing these three conditions are the following:

1. Aspiration of hydrocele or drainage of abscess in order that the lesions of testicle and epididymis may be accurately palpated.

2. Familiarity with the clinical aspect of tuberculosis of the testicle —the little rounded nodules; the diffuse infiltration of the epididymis; the acute epididymo-orchitis; the frequency of hydrocele and abscess; the ever-present sensitiveness to pressure.

3. Tubercular family history, upon which too much weight must not be placed, and tubercular personal history, which is often an important aid in diagnosis.

4. Evidences of tuberculosis in the internal genital organs, as evinced by active tubercular lesions, chronic tubercular nodules or a slight haze in the urine and some pus in the prostate (which may be expressed by massage).

5. The diagnosis can be clinched by discovery of the tubercle bacillus in the urine, in the pus massaged from prostate, or in the contents of hydrocele fluid or abscess.

6. Still further confirmation may be obtained by operation.

Yet that these signs may all fail I am sure from several cases in which the careful and close observation of months failed to distinguish absolutely between tuberculosis and other lesions.

TREATMENT

Hygienic Treatment.—The hygienic treatment of tuberculosis is as efficient in tubercular testis as in phthisis. It is the foundation of every cure.

Tuberculin Treatment.—I have used this in vain.

Surgical Treatment.—Let us first discuss the treatment of hydrocele and of abscess, for on these all agree.

Hydrocele.—Small hydroceles need not be disturbed. They usually disappear with the subsidence of the acute process. Large ones may be tapped by way of palliation or may form an excuse for radical operation.

Occasionally a hydrocele of tubercular origin is cured by injection of carbolic acid.

Abscess and Fistula.—These must be kept open and treated by Bier cups.

Shall Radical Operation be Performed?—I array myself among the most conservative. I believe that the removal of one testicle tends, if

anything, to encourage recurrence on the opposite side. While I am not absolutely convinced as to the physical effect of removing one testicle, I know of few worse moral effects than that produced by relapse on the opposite side after such an operation. I have not seen any generalization of the disease immediately after operation, such as some surgeons have reported; but, nevertheless, I am perfectly confident that the knife never removes all the disease, even when the entire tubercular testis with its cord and vesicle is taken away. All that the knife can do is to remove the most active focus of the disease, and this is best accomplished by conservative surgery, not by radical measures. When the inflammation does not subside under hygienic treatment, the surgical requirements of the case may usually be met by epididymectomy or by incision of suppurating foci.

On the other hand, I have seen every form of tubercular disease bettered and permanently cured by hygienic and dietetic measures, and these should always be accorded precedence, if for no other reason, at least because of the uncertainty of the disease.

To speak practically, the patient with a tubercular testicle should wear a suspensory bandage. He should be encouraged to take every advantage of sunlight and climate that his station in life permits. He should be treated with general tonics and antitubercular remedies according to the surgeon's judgment. Local remedies are useless. The injection of an iodoform glycerin emulsion (Senn) or of a 10-per-cent chlorid-of-zinc solution (Lannelongue) has met with little favor.

Epididymectomy should be performed if the disease grows worse in spite of palliative treatment. When any of the tubercular lesions soften or begin to adhere to the skin they should be opened and scraped at once. The surgeon may take this opportunity to lay open other points of threatening suppuration, or he may shell off the entire epididymis from the testicle, dividing the vas at or near the external abdominal ring. If the vas is involved beyond this point, the incision may be prolonged upward and outward over the inguinal canal, and the vas freed and followed down to the vesicle, where it may be divided. If the abscess involves the testicle I like to burn its walls with the Paquelin cautery.

I accept only two indications for castration, the destruction of the testicle by suppuration, and, in some cases, the hyperacute, galloping tubercular orchitis (usually due to mixed infection).

One of the arguments of those who condemn epidymectomy is that it always leaves some tuberculosis in the testis. I do not doubt the truth of this statement. Indeed, I have deliberately left a testicle full of tubercles in two of these cases and seen it subside and give no further trouble. Some of the results have been peculiarly brilliant. Two of them scarcely show the least departure from a normal appearance, the

scar of the epididymectomy having quite accurately reproduced the form of the epididymis itself.

All operations should be performed under general anesthesia, in order that the surgeon may have the opportunity to do his work thoroughly, unhampered by the patient's outcry. When epididymectomy is performed primary union may often be expected. Curetting and cauterizing operations should be terminated by drainage. Fungus may be amputated by the cautery, turned in and covered by the scrotum. If this operation fails castration is necessary. Pousson [1] has advocated ligature of the spermatic cord as a cure for tubercular testis. The suggestion is too new to receive calm judgment.

If the seminal vesicle is tubercular the question of operating upon it may arise (p. 476).

[1] *Guyon's Annales*, 1900, xviii, 356.

CHAPTER XLIV

MOVABLE KIDNEY

The kidney is naturally endowed with a certain degree of mobility. Like the other abdominal viscera it moves with respiration and its position is influenced by the attitude of the subject. Yet this condition is entirely normal. Such a kidney is not distinctly palpable. A movable kidney, on the other hand, is one that is subject to downward displacement to such an extent that it may be distinctly palpated by the usual methods of examination. English authors distinguish between movable kidney and floating kidney. The former is subject to downward displacement only behind the peritoneum; the latter may also be displaced forward toward the anterior abdominal wall, and often possesses a mesonephron. Continental writers distinguish mobility of the first degree (the fingers can grasp the kidney), the second degree (the fingers can be brought together above the organ), and the third degree (the kidney can be depressed into the iliac fossa).

FREQUENCY

The recorded frequency of movable kidney varies with the point of view of the author and the delicacy of his sense of touch. The widely divergent opinions of various writers may be tabulated thus:

	Women.		Per Cent.	Men.		Per Cent.
	Cases Examined.	Movable Kidney.		Cases Examined.	Movable Kidney.	
Bergmann [1]	905	40	4.41	828	4	0.48
Einhorn [2]	543	112	20	772	14	1.81
Idem [3]	832	240	28	1,080	42	3.88
Mathieu [4]	306	85	25	...	..	....
Godard-Danhieux [5]	603	212	35	268	6	2.33
Suckling [6]	100	42	42	100	6	6
Harris [7]	126	71	56	...	..	....

[1] *Op. cit.*, p. 134.
[2] *Med. Record*, 1898, liv, 220.
[3] *Ibid.*, 1901, lix, 561.
[4] *Le bull. méd.*, 1893, vii, 1113.
[5] *Guyon's Annales*, 1901, xix, 197.
[6] *Edinb. Med. Jour.*, 1898, iv, 228.
[7] *Jour. of the Am. Med. Assoc.*, 1901, xxxvi, 1527.

Many of these statistics are obviously compiled in *camera*, and represent only the physician's interpretation of the term "movable kidney" without any reference to the patient's symptoms. The average observer will probably recognize a movable kidney in 20 per cent of women and 2 per cent of men; yet the cases which have symptoms and require treatment are far fewer than this.

There is a general agreement that in 8 cases out of 10 the right kidney only is movable; of the remainder the majority are bilateral, unilateral left-sided nephroptosis being most unusual. When both kidneys are movable, the right kidney is usually more movable than the left.

Although movable kidneys have been discovered in patients of all ages, as a rule the symptoms of the disease appear in the third decade of life and disappear between the fortieth and fiftieth years.

PATHOGENESIS

To be satisfactory, a theory must explain (*a*) the predominance of movable kidney in woman, (*b*) the frequency with which it occurs on the right side, and (*c*) its importance between the ages of twenty and forty.

We shall consider:

a. Causes of Congenital Nephroptosis.

b. Causes of Acquired Nephroptosis.

Primary Predisposing Cause.—Shape of the lumbar recess.

Secondary Predisposing Causes { Enteroptosis. Pregnancy. Emaciation.

Exciting Causes { Corsets. Trauma.

a. **Causes of Congenital Nephroptosis.**—The existence of congenital nephroptosis has been doubted, but the possibility of such a condition is proved by such cases as Dr. W. R. Stewart's. In this case an exploratory operation performed for intestinal obstruction on an infant eight months old disclosed a floating kidney. Abt [1] and Morris have collected similar cases. Yet the discovery of a movable kidney in a child is undoubtedly exceptional, and the presence of any symptoms before puberty is rarer still.

With our present knowledge it is impossible to say what may be the cause of this condition. It has not been determined how far the factors that operate in later life are at work, and how great a part actual abnormal development plays.

[1] *Jour. of the Am. Med. Assoc.*, 1901, xxxvi, 1166.

b. **Causes of Acquired Nephroptosis.**—**Primary Predisposing Cause.**—Wolkow and Delitzen [1] have shown by an extensive series of pathological investigations that there is quite a wide variation in the size of the niche in the loin occupied by the kidney. The paravertebral niche, as they call it, is shallower in women than in men, shallower on the right side [2] than on the left. The feminine peculiarity appears with the broadening of the pelvis at the advent of puberty; and it is this feminine, right-sided shallowness of the bed in which the kidney lies that is the chief predisposing cause of nephroptosis. Harris has gone even further, and maintains that the chief characteristics of the body form that predispose to nephroptosis "are a marked contraction of the middle zone of the body with a diminution in the capacity of this portion of the body cavity. This diminution in the capacity of the middle zone depresses the kidney, so that the constricted outlet of the zone comes above the center of the organ, and all acts, such as coughing, straining, lifting, flexions of the body, etc., which tend to adduct the lower ribs, press on the upper pole of the kidney and crowd it still farther downward. It is the long-continued repetition, in a suitable body form, of these influences, which collectively may be called internal traumata, that gradually produces a movable kidney." Not everyone is willing to lay so much stress on the predisposing cause, though Wolkow and Delitzen have proved that its influence has been much underrated.[3]

Secondary Predisposing Causes.—The internal traumata just mentioned, and many others, such as intermittent renal congestion during menstruation, prolapse, and inflammation of the pelvic organs, etc., may be included here; but we need discuss only four alleged causes—viz., enteroptosis, weakness of the abdominal wall, pregnancy, and emaciation.

Enteroptosis is a general condition, of which nephroptosis is often one of the features. Glenard [4] considers that nephroptosis never exists without a general enteroptosis, but he stands alone in this opinion. Einhorn [5] has seen 27 cases of enteroptosis without nephroptosis, and 213 cases in which both conditions existed; hepatoptosis occurred with nephroptosis only 30 times, 54 times without it; while in 57 cases only the kidney was movable. Similarly Godard-Danhieux [6] records 131 cases of nephroptosis without enteroptosis, and 81 cases with it; while in 97 instances there was enteroptosis without nephroptosis. Obviously,

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[1] "Die Wanderniere," 1899, Berlin.

[2] Chiefly because the liver fills the upper segment of the niche on this side.

[3] The theory that enteroptosis is an evidence of degeneracy has been propounded by Stiller, Tuffier, and Albarran, but this theory has not met with general acceptance.

[4] "Les Ptoses viscérales," Paris, 1899. *Lyon méd.*, 1885, xliv, 8.

[5] *Med. Record*, 1898, liv, 220; 1899, lvi, 397; and 1901, lix, 561.

[6] *Gaz. hebd.*, 1900, v, 159.

then, enteroptosis plays only a secondary rôle. When the two coexist it is quite as possible they are due to similar causes as that the one depends upon the other. One can comprehend how a loose liver should depress the kidney below it and favor its mobility; but general enteroptosis can influence the position of the kidney only by leaving room for its displacement.

Pregnancy introduces another dispute. It is an accepted fact that repeated pregnancies favor relaxation of the abdominal wall and enteroptosis, yet there is an absolute disagreement in the statistics on nephroptosis. Landau, Senator, Moulin, Morris, and others maintain that movable kidney is more frequent in women who have borne children, while Küttner, Godard-Danhieux, and Lindner defend the opposite theory. It would certainly seem probable that the tendency to mobility in a kidney should be increased by the abdominal strain of parturition, and the resultant abdominal flaccidity.

Weakness of the abdominal wall, Wolkow and Delitzen insist, is a strong predisposing factor in enteroptosis and nephroptosis. The abdominal viscera are deprived of their necessary support, and therefore sag downward, carrying the kidneys with them, in case the shallowness of the paravertebral niches makes these organs liable to prolapse.

Emaciation, it is stated, causes nephroptosis by absorption of the perirenal fat. Morris has often noted the small quantity of fat that surrounds kidneys requiring nephrorrhaphy. Yet one can scarcely believe that the absorption of fat could be so sudden as to leave a space into which the kidney would sag. On the other hand, it is quite conceivable that the excursions of a movable kidney should discourage the deposition of fat within its fascial envelope.

Exciting Causes.—*Corsets* have been alternately praised and condemned. A corset that brings pressure to bear below the kidney region will, if applied while the kidney is in place, help to retain a movable organ; while a long-waisted corset that compresses the ribs is equally likely to encourage renal mobility. The fact that Egyptians suffer from movable kidney is evidence that the corset does not deserve all the blame which has been heaped upon it. Yet it does weaken the abdominal wall and so increases the liability to nephroptosis.

Trauma of one sort or another is certainly the exciting cause of all cases of movable kidney. But it is equally certain that the trauma in question is usually of a mild type. Suckling mentions the influence of constant stooping. The internal traumata recognized by Harris have been enumerated. The influence of pregnancy and corsets has already been mentioned. Bergmann insists upon the evil effect of horseback riding.

The effect of acute trauma, such as falls, kicks, and blows, is an open question. Harris absolutely denies its influence, and though many acute

cases from this cause have been enumerated, I believe that in most instances the trauma has been only the cause of symptoms in an organ already movable.

PATHOLOGY

Congenital Mobility.—"A floating kidney with a mesonephron is, of course, always congenital" (Morris). Such cases are rare;[1] but it is also possible that the kidney should be congenitally movable behind the peritoneum.

Acquired Mobility.—The kidney may be movable within its fatty capsule, or fat and kidney may move together within the fascia. The adrenal does not habitually move with the kidney. The kidney, however great its acquired mobility, does not come to have a mesonephron. It moves about behind the peritoneum.

Secondary Changes.—As a result of long-continued mobility the *renal vessels* may become considerably lengthened. They are the radii of the circle in which the kidney moves; as they lengthen mobility increases.

The *ureter* may become kinked, and in this event, which is by no means uncommon, the free outflow of urine is obstructed and the kidney becomes hydronephrotic. Kinking of the ureter is due to the fact that it is held fast to the peritoneum, and therefore cannot partake in the renal excursion.

Adhesions may form as a result of repeated attacks of hydronephrosis or of other inflammation of the kidney itself or of the surrounding tissues. Such adhesions increase the ureteral obstruction.

The secondary changes in the kidney are those of hydronephrosis.

Exceptionally *gangrene of the kidney* has occurred from torsion of the pedicle.

SYMPTOMS

So as to bring order out of the contradictory opinions concerning the symptoms of movable kidney, we may take as the basis of our description a few commonly accepted facts. In the first place, any surgeon familiar with abdominal palpation appreciates that, in examining a patient, one occasionally finds a movable kidney which has never given any symptoms, and of whose existence the patient will not become aware unless the surgeon announces his discovery. A second class of cases, while having a movable kidney and suffering from various symptoms—digestive, neurotic, or pelvic—have no symptoms directly referable to the kidney itself. The organ is neither tender, adherent, nor enlarged. There is no history of hydronephrosis, no evidence of either urinary infection or renal sclerosis. Finally, there are other cases with symptoms

[1] Their very existence is denied by Albarran.

directly referable to the kidney itself. Thus nephroptosis is encountered clinically under three aspects:

1. Nephroptosis without symptoms.
2. Nephroptosis without symptoms directly referable to the kidney.
3. Nephroptosis with symptoms directly referable to the kidney.

Nephroptosis without Symptoms directly Referable to the Kidney.—The greater number of cases commonly classed as movable kidney come under this head, and it is the infinite variety of symptoms which such cases present, the doubtful origin of these symptoms, and the uncertainty of their cure, that has obscured the whole subject and given rise to opinions so divergent and to discussions so virulent. And so long as man retains his individuality opinions upon this subject must continue to differ. Therefore I shall not attempt the futile task of reconciliation, but shall rest satisfied with expressing a point of view which may afford a basis for discrimination in the surgical treatment of this malady which, after all, is the main point at issue.

The class of cases under discussion has but two common features: (1) The subjective symptoms are referable to any one of several diseases of organs other than the kidneys, and (2) one or both kidneys are movable, but present no signs, either subjective (pain) or objective, of disease. Such patients may present nervous symptoms, digestive disorders, or painful symptoms. These symptoms are exhibited in greater or less degree and in various combinations.

Nervous Symptoms.—It is quite impracticable to detail here the various symptoms of neurasthenia with abdominal manifestations that have been attributed to renal mobility. Their name is legion. But the question that always arises is, Does the neurasthenia depend upon the movable kidney? Two answers may be suggested. If temporary reposition of the affected organ brings temporary relief from the symptoms, and if with renewal of the kidney prolapse the symptoms recur, there is, clinically speaking, an established connection between the mobility of the kidney and the nervous symptoms. In the second place, it may be found that, perhaps as a result of slight retention from kinking of the ureter, there is interstitial nephritis. In this case the nervous symptoms may possibly be attributed to renal autointoxication.

Digestive Disorders.—The flatulent dyspepsia and constipation that figure so prominently among the symptoms of nephroptosis are but rarely referable to the kidney. Einhorn's opinion upon this subject deserves quotation:

> Most of the gastric and intestinal symptoms, such as pains, eructations, nausea, occasional vomiting, irregularity of the bowels (chiefly constipation, sometimes diarrhea), which are present in persons with movable kidney, occur usually independently of the latter, and require therapeutic measures

appropriate to such conditions. Gastric neuroses, which originate by reflex action from a movable kidney, are met with but rarely; among them I would place nervous vomiting and nausea. Whether cases of periodic attacks of continued gastro-succorrhea can be regarded as reflex symptoms of a movable kidney appears to me doubtful. Of course these conditions are found in patients suffering from movable kidney, yet I have observed cases in which neither the wearing of an abdominal bandage nor the performance of nephrorrhaphy caused the disappearance of the periodic gastro-succorrhea.

Here, again, the tests applied to the neurotic cases are of service. If reposition of the kidney relieves the symptoms, or if there is renal insufficiency, some connection between the renal condition and the digestive disturbance may be suspected.

We may mention here the theory maintained by Edebohls [1] that movable kidney on the right side may cause chronic appendicitis by pressure upon the superior mesenteric vein. The relative infrequency of appendicitis in women discourages this belief.

Painful Symptoms.—The pains most often caused by movable kidney are: (1) Pain and tenderness in the kidney itself. (2) Pain of a dull, dragging character low down in the back, a pain comparable to that commonly attributed to uterine retrodisplacement. (3) Frequent and painful urination. It is characteristic that these pains should be increased by exercise, and should be more severe during the menstrual period. It is evident that any of them, except the first, may be attributable to conditions other than nephroptosis. Therefore it is essential that they should be known to disappear with reposition of the kidney, and to reappear with its prolapse before we can be sure of any connection between the pain and the renal mobility.

Nephroptosis with Symptoms directly Referable to the Kidney.—Here we enter upon a more definite field of investigation. If the kidney is tender and painful, if the tenderness is relieved by reposition of the organ, if there is renal colic, or if the tender kidney is enlarged or adherent in an abnormal position, we have direct physical evidence that the symptom is due to the nephroptosis. Even more characteristic is the *intermittent hydronephrosis* due to movable kidney. This condition in its fully developed form is unmistakable. The patient comes with history of a tumor in the flank. This tumor gradually grows larger during a few days or weeks and then suddenly disappears. There is an interval of a few days and then the tumor once more begins to grow. It is usually very painful and tender, and its growth is often attended by *renal colic* (Dietl's crises), while its disappearance is signaled by relief of the pain and accompanied by the discharge of an ex-

[1] *Post-Graduate*, 1899, xiv, 85.

cessive quantity of urine. In other cases the kidney does not fill sufficiently to give a perceptible tumor, but there are repeated attacks of renal colic without passage of stones or evidences of pyelo-nephritis. Examination then reveals a movable kidney, swollen and tender during paroxysms.

The outcome of these obstructive cases is that of *hydronephrosis*. Intermittent *pyonephrosis* may also occur.

DIAGNOSIS

If the kidney is only slightly movable this may be detected by ballottement and the other methods of renal palpation. A floating organ may be discovered almost anywhere in the abdomen. As a rule, it is not difficult to distinguish a floating kidney from other abdominal tumors. The very mobility of the organ, the fact that it may be replaced in the loin, together with its general contour, and the sickening sensation, similar to and yet not the same as the ovarian sensation, caused by pressure upon it, are sufficiently characteristic. Tumors arising from the ovaries or uterus may be distinguished by their pelvic attachments. To distinguish a movable kidney from a distended gall-bladder, Morris proposes the following criteria: (1) The enlarged gall-bladder, as well as the kidney, is a frequent cause of *movable* abdominal tumor. (2) History of jaundice. (3) The tumor caused by an enlarged gall-bladder can, in almost every case, at all times be felt, whereas a movable kidney (unless also enlarged) cannot. (4) Variability in the size of the tumor goes for nothing

FIG. 100. — MOVABLE KIDNEY INJECTED WITH ARGYROL. (Radiograph by Dr. MacKee.) Patient had had a Dietl crisis. Injection shows absence of hydronephrosis or kinking. Lower pole of kidney shows well.

unless associated with sudden diuresis. (5) A calculous gall-bladder feels much harder than a movable kidney. (6) The radius of mobility of the gall-bladder differs from that of the kidney. Morris also mentions the fact that the two conditions often coexist, and that inflation of the colon for the purpose of pushing the kidney outward and the gall-bladder upward is a most unreliable means of diagnosis, since the hepatic flexure of the colon may be displaced downward and inward when either affection exists. The ultimate method of diagnosis in a doubtful case is ureter catheterization as for hydronephrosis.

Exploratory aspiration cannot be too strongly condemned.

But the discovery of a movable kidney by no means completes the diagnosis. It is equally important to ascertain whether the symptoms are due to the nephroptosis or to something else. In some cases there can be no doubt that the kidney is at fault. If a hydronephrosis, a pyonephrosis, or an adherent organ is discovered, here is a pathological condition demanding treatment. Then there are the tender kidneys and those cases whose symptoms are temporarily relieved by rest and reposition of the displaced organ. These form a doubtful class, and merit the most minute examination and the closest watching, of which the palliative treatment of the disease forms an important part. The majority of them are complicated by some neurotic tendency, enteroptosis, or gastro-intestinal or pelvic disease. Their judicious treatment is peculiarly difficult. Finally, there are the cases in which no test can show a direct connection between the renal ptosis and the symptoms.

TREATMENT

In deciding upon the proper course of treatment for any individual case of movable kidney, the surgeon must bear in mind the following facts:

1. In many cases nephroptosis produces no symptoms.

2. In many instances nephropexy, while it retains the kidney in place (which it does not always do), either fails to relieve or aggravates the neurotic or dyspeptic symptoms attributed to renal mobility.

In view of these facts we must hesitate to elect nephropexy, a treatment which, though surgically a success, may prove clinically a failure, or worse than a failure. Mechanical treatment—supporting the kidney by a suitable belt—may always be experimentally employed in doubtful cases. But to have recourse to surgery is a grave matter. Not because of the danger or discomfort connected with the operation, for the former is almost nil, the latter inconsiderable, but because in most instances the patient is distinctly neurotic, and, while the influence of the operation *per se* may be beneficial, it may also be injurious. In short, the knife is no proper instrument for a faith cure. Its brilliant successes should

not blind us to its failures. Yet where palliative measures fail, and the symptoms are apparently dependent upon the renal mobility and require relief, there is no choice. An operation is then surely the lesser evil. So we may conclude that *the treatment of subjective symptoms due to renal mobility is palliative; surgical measures should be reserved for the treatment of hydronephrosis and other similar pathological conditions that cannot be relieved without them, and for those cases that do not respond to persistent, intelligent palliative treatment.*

Palliative Treatment.—The broad lines of palliative treatment are:

1. To remedy digestive and menstrual derangements.
2. To regulate exercise so as to avoid overfatigue.
3. To improve the general vitality and combat neurasthenia by overfeeding, massage, hygiene, electricity, and tonics, and
4. To apply an abdominal supporter.

Much emphasis is placed upon the kind of belt or corset employed to support the abdomen. Edebohls [1] reviews the opinions of various writers upon this subject, even to that of Gurtzburg, who "administers a yeast ferment with the object of producing meteorism, and thus sustaining the prolapsed kidney." This is an extreme example of the fallacious impression that a support must be worn solely for the purpose of retaining a kidney in place, and that, this accomplished, the cure is assured. Nothing could be further from the truth. As a matter of fact, it is the patient's general condition that should be attacked primarily, the local condition only secondarily. Many a case of "movable kidney" is cured by hygiene, diet, and exercise, while the kidney remains as loose as ever. Moreover, in applying a belt or a corset the effort must be made to support all the abdominal viscera, not the kidney only. It is not conceivable that any form of pad should hold the kidney in place, and therefore it is wiser to dispense entirely with pads and to support the abdominal contents *en masse*. For this purpose the modern straight-front corset may be employed. Some women find that this article, if applied in the recumbent position, acts as an admirable supporter. If this fails a snug elastic abdominal belt should be tried. And all the while the systemic treatment must be attended to.

Surgical Treatment.—Nephropexy.—Nephropexy (nephrorrhaphy) is the operation of fixing the prolapsed kidney against the abdominal wall.

Results of Nephropexy.—The earlier nephropexies were so uniformly followed by relapse that many physicians opposed the operation on the ground that a permanent cure was *never* accomplished by operation; but recent statistics tell an entirely different story. Morris has performed

[1] *Med. Record*, 1901, lix, 690.

98 nephropexies with 1 death ("cardiac thrombosis in a stout female whose kidney was incised and explored before being fixed"), and only "a few" relapses after operations performed according to "a plan different from the present methods." Edebohls reports 193 cases (68 bilateral), with 3 deaths and 2 known relapses. All of my own cases have been successful.

But nephropexy may be regarded from another point of view. In a very considerable proportion of cases the patients have complained of more pain after the operation than before. This may be due to one of several factors: perhaps the pain did not commence in the kidney, and therefore was not relieved by operation, but was rather intensified by the shock and disappointment; or perhaps it was due to adhesions or kinks of the ureter which were not relieved by the surgeon; or perhaps the kidney was replaced high up in the loin in a niche from which it had descended because there was not sufficient room for it (Harris). However this may be, I have had only one patient complain of a recurrence of pain. Nephropexy was performed upon her as a lesser evil than exploratory abdominal section, with which she was threatened by another surgeon. Her various neurotic symptoms, which had existed for years, immediately disappeared. Five years later they returned, and she underwent at the hands of various surgeons the extraction of several teeth, drainage of the antrum of Highmore, excision of the inferior dental nerve, nephrectomy (the kidney was found firmly adherent), vesico-vaginal fistulization, an infinite variety of other treatments, all to no avail. It has been interesting to find two reports of her cure, the one by a dentist, the other by a physician. Finally, exploratory laparotomy was performed a year ago. A normal appendix was removed—and she has remained better ever since, though far from well. She has recently been poisoned by a rectal injection of boric acid, but survived!

CHAPTER XLV

THE URETERS AND THEIR DISEASES

ANATOMY

The ureter is the excretory duct of the kidney. It is a fibro-muscular tube beginning at the funnel-shaped neck of the renal pelvis and terminating at the lateral angle of the trigone of the bladder. There is normally one ureter for each kidney. Each ureter is from 35 to 40 cm. (14 to 16 inches) long. The ureter is, when empty, a closed tube like the urethra. Its physiological caliber is that of a cylinder about 0.3 cm. ($\frac{1}{8}$ inch) in diameter. The lumen of the ureter is slightly constricted at three points: (1) A distinct narrowing at a point about 2 cm. from its upper extremity, (2) a slight narrowing where it crosses the brim of the pelvis, and (3) a muscular constriction at its entrance into the bladder.

Structure.—The ureter is composed of three coats: the fibrous, the muscular, and the mucous.

The *fibrous* external coat runs continuously from the fibrous envelope of the kidney and its pelvis to the bladder. It is a tough, glistening, elastic tissue.

The *muscular* coat consists of an external longitudinal and an internal circular layer of smooth muscle. It is well developed in both the ureter and the pelvis of the kidney. In the calices it thins out to a few stray fibers. At the vesical extremity of the ureter its muscle pierces that of the bladder and is continued as a band of fibers running along each edge of the trigone. Thus there is one band joining the two ureters (interureteric muscle) which sometimes raises a distinct transverse fold in the mucous membrane, while another thinner band of fibers runs from each ureter toward the neck of the bladder. The ureter possesses no proper sphincter. Its power of resisting regurgitation from the bladder is due to its oblique course through the muscular wall of the bladder, and to the constriction of the bladder muscle, which automatically closes the ureteral orifices as it contracts to force the urine into the urethra.

The *mucous membrane* of the ureter is smooth and thrown into longitudinal folds when the organ is collapsed. The epithelium consists of

several superposed layers, the deeper ones conical or ovoidal, the superficial ones cuboidal or flattened. Though some expert microscopists claim to be able to distinguish the epithelium of the pelvis of the kidney from that of the ureter, most conservative observers confess their inability to make such a distinction, and do not even venture to assert that any given cells in the urine come from any part of the ureter or its pelvis unless the presumption is confirmed by other signs, notably the presence of renal casts and albumin.

Relations.—The ureter lies immediately behind the peritoneum throughout almost its whole length. It is firmly attached to this structure, so that when the peritoneum is detached from the parietes it carries the ureter with it. When this dissection is performed by the finger the ureter may be identified as a cord interrupting the smooth yielding surface of the peritoneum within 3 cm. ($1\frac{1}{2}$ inches) of the spinal column. In the abdomen the ureter lies upon the psoas muscle and crosses the genito-crural nerve. It is in turn crossed by the spermatic (or ovarian) vessels. On the right side it lies close to the vena cava. At the brim of the pelvis it crosses the common iliac vessels at or near their termination. Thence it plunges down in a fold of peritoneum (posterior false ligament of the bladder), passes under the arch of the vas deferens, and lies external to it, entering the bladder wall close above the seminal vesicle and about 2 cm. from the median line. Thence it runs 2 cm. obliquely forward and inward through the bladder muscle and beneath the mucous membrane, and emerges at the angle of the trigone 3 cm. from its fellow and the same distance from the urethral orifice.

Topographical Anatomy.—The ureter, like the kidney, can very rarely be felt when in a normal state. When tender or enlarged, however, in a thin subject it may be traced almost from the kidney to the brim of the pelvis. In fleshy subjects it can only be felt at this latter point—viz., at the outer edge of the rectus muscle on a line joining the anterior spines of the ilia. Tenderness at this point can always be distinguished by palpation, and if the patient is not overfat an enlarged ureter can be rolled between the finger and the iliac artery. In the female pelvis the diseased ureter is felt through the vaginal vault almost up to the pelvic brim. But in the male it is only in exceptional cases that tenderness or enlargement at the lower extremity of the ureter can be appreciated by rectal touch in the region just internal to the base of the seminal vesicle.

PHYSIOLOGY

The ureter transmits the urine from the kidney to the bladder partly through the force of gravity, but chiefly by its peristaltic action. Waves of contraction run along it quite as they do along the intestine, and as each wave reaches the bladder the ureteral orifice becomes slightly raised

and tumefied, emits a little jet of urine, and then sinks back again. This is perhaps the most picturesque phenomenon observable through the cystoscope. The contractions of the two ureters are quite independent and not often synchronous. They recur irregularly every five, ten, or twenty seconds. Exceptionally the intervals are much longer.

Like the bladder, the ureter is insensitive to touch unless inflamed. But, like the bladder, it is extremely sensitive to distention—witness the agonizing pain of renal colic. Whether those obscure cases of renal colic attending the passage of concentrated crystalline urine are due to distention or to simple scratching of the ureteral walls it is impossible to say. Dr. Bryson has advanced the theory that pain of the upper third of the ureter is radiated to the kidney, pain of the middle third to the abdomen, and pain of the lower third to the bladder and urethra. While this is usually the case, the vesical pain of renal origin, which so often mystifies the most expert, is often due to a disturbance solely in the renal pelvis without any implication of the ureter.

EXAMINATION

The methods of examining the ureter are reducible to two: (1) Palpation (Chapter I); (2) urethral catheterization and its various modifications (Chapter V).

MALFORMATIONS

These are described on p. 585.

URETERITIS AND STRICTURE

Ureteritis, whether due to pyogenic bacteria alone or excited by stone or tuberculosis, is but a feature of the larger renal condition and is accordingly considered therewith.

Ureteral stricture results from one or other of the above conditions.

Stricture may not be distinguished from angulation of the ureter, even when the urinary channels are manifestly dilated above the point of stricture.

The *treatment* of such angulations and strictures is operative, as a rule.

Dilatation of stricture by olivary tipped ureter bougies of graduated sizes has occasionally been accomplished, but the stone, tuberculosis, angulation, or pyonephrosis that so usually accompany stricture demand radical treatment.

URETERAL NEOPLASMS

Cysts of the ureter are extremely rare. Mucous cysts may occur, and cystitis cystica usually extends up the ureters.

Epithelial Growths.—The solid neoplasms of the ureter are epithelial formations, papilloma, carcinoma, and epithelioma.[1] These tumors have been studied by Albarran,[2] who has collected 65 cases. Their histogenesis is quite the same as that of vesical tumors. They usually begin as seemingly benign growths and become malignant secondarily, arising in the renal pelvis and being propagated downward by direct extension or by implantation. In the kidney they may produce secondary deposits or give rise to hydronephrosis, hematonephrosis, or pyonephrosis. The kidney, bladder, retro-peritoneal glands, and less often the liver or the pleura, may be involved secondarily. The youngest patient was twenty-seven years old, the oldest eighty-nine. In 8 cases there was stone in the kidney.

Symptoms.—The symptoms are those of renal stone or tumor. Bleeding is usually noted (79 per cent) and is often the first symptom. Tumor was noted in 70 per cent of the cases, pain in 60 per cent. The diagnosis has been made only by the observation (through a cystoscope) of a villous tumor protruding from the ureteral orifice. The tumor has otherwise been either unrecognized or mistaken for a renal growth. Albarran suggests the possibility of diagnosis by the urine obtained from a ureteral catheter. If the urine is bloody, not purulent, and yet contains cylindrical or pavimentous epithelium, there must be an epithelial neoplasm. In the presence of pus, however, this sign is of no value, since such cells occur abundantly in chronic pyelitis. As a matter of fact, however, the diagnosis is made only when nephrectomy is undertaken for supposed renal growth.

Treatment.—The treatment is wholly operative. Nephrectomy has been performed 21 times, with 3 deaths and 8 known recurrences. One case of papilloma was known to be well fourteen months, and 2 of carcinoma four and six years after operation.

Inasmuch as the recurrence almost invariably appears in the ureteral stump, this duct should be removed entire. Cystoscopy will determine whether a portion of the adjacent bladder wall should be resected with the tumor.

URETERAL FISTULÆ

Ureteral fistulæ have many causes. Congenital uretero-rectal and ureteral-vaginal fistulæ are extremely rare. In these cases it is usually

[1] Morris has, however, collected 3 reported cases of sarcoma.

[2] "Les tumeurs du rein," Paris, 1903.

possible to make an opening into the bladder through a suprapubic wound. The termination of the ureter is then obliterated by extirpation or cauterization. Acquired fistulæ, on the contrary, occur in any portion of the ureter: at the upper end after nephrectomy, especially if the ureter is actively tuberculous. In other parts of its course cutaneous fistulæ form after the duct has been inadvertently divided during an abdominal operation or after rupture from stone, stricture, or other disease, such as tuberculosis and neoplasm, or from trauma or pressure of some intra-abdominal growth usually of the uterus or ovary, or from injuries inflicted during labor.

The discharge from the ureteral fistula is usually uro-purulent, sometimes simply purulent, and rarely simply urinary. The presence of urine in the discharge may be taken as presumptive evidence that the fistulous ureter leads up to a functionating kidney. Yet the presence of urine does not prove a connection with the kidney, for the urine may regurgitate from the bladder through a ureteral fistula, if the ureter is gravely diseased.

Treatment.—The treatment of cutaneous fistula is ureterectomy if the kidney has ceased to functionate, ureteral anastomosis or some allied procedure if the kidney is worth saving.

The treatment of uretero-vaginal and uretero-uterine fistula is no simple matter. The great variety of operations employed for its cure, the great proportion of failures after most of these, and the total absence of concerted surgical opinion upon the subject, attest the complexity of the problem. While the number of operations is legion and the choice among them lies rather with the gynecologist than with the genito-urinary surgeon, a few simple principles may here be laid down.

When practicable Tuffier's [1] operation should be employed, as it combines the attributes of simplicity and perfect safety. The steps of the operation are as follows: (1) Introduce a director into the fistulous opening, and, using this as a guide, dissect free the lower 2 or 3 cm. of the duct. (2) Split up the orifice for 1 cm. in order to insure an ample opening. (3) Make a triangular opening in the most accessible point of the bladder wall (pushed down by a sound). (4) Suture the ureteral and vesical mucous membranes with catgut and the muscular layers with silk. Finally, close the wound in the anterior vaginal wall. A ureteral catheter, or at least a permanent vesical catheter, is necessary for the first week after operation.

If this operation fails or is impracticable, abdominal uretero-cystoneostomy should be tried and should succeed. Hysterocleisis and colpocleisis are operations of last resort. The functional result of including the uterus or the vagina in the urinary reservoir is anything but satis-

[1] *Bull. de la soc. de chir.*, 1895, xxi, 270.

factory. If all attempts at uretero-vesical anastomosis fail and the opposite kidney is healthy, nephrectomy would be preferable to colpocleisis. Let it not be forgotten, however, that at least once the wrong kidney has been removed. This deplorable accident may, for a certainty, be avoided by catheterization of the fistulous ureter at the time of operation and palpation of the catheter within the pelvis of the organ to be removed.

CHAPTER XLVI

HYDRONEPHROSIS

Obstruction to the outflow of urine from the kidney is of two kinds: 1. Sudden complete obstruction. 2. Gradual or incomplete obstruction.

Sudden complete obstruction occurs clinically under two forms—viz., by a calculus and by the surgeon's ligation. In either event the result is the same. The urine is dammed back upon the kidney, causing an acute renal congestion (Fig. 83) and a diminished secretion of urine; but even this increases the intrarenal pressure. The congestion is exchanged for atrophy after little dilatation has occurred, thus terminating the usefulness of the organ. The details of these changes do not interest us at present. They are fully described under Calculous Anuria.

Gradual, incomplete, or intermittent urinary obstruction sets up a very different train of events. Some urine escapes past the obstruction, continuously or from time to time, and affords partial relief to the renal tension, while still keeping up a very considerable pressure. Thus the organ does not atrophy. It continues to excrete an amount of urine equivalent to what can pass the obstruction, while the continued high pressure within the kidney causes a gradual dilatation of its cavity. Pelvis and calices gradually dilate—and there is hydronephrosis (cystonephrosis, nephrectasis, renal distention, uronephrosis).

The above-described pathogenesis of renal atrophy and hydronephrosis has been experimentally worked out by Guyon,[1] Byron Robinson,[2] and others, and confirmed by observations in clinic and deadhouse.

ETIOLOGY

The cause of hydronephrosis is gradual, incomplete, or intermittent urinary obstruction. The obstruction may be urethral or ureteral.

Urethral Obstruction.—The common urethral obstructions are stricture of the canal and hypertrophy of the prostate. But the former always and the latter usually damages the kidneys more by infection than by dilatation. The bladder bears the brunt of the distention, and,

[1] *Guyon's Annales*, 1892, x, 161.

[2] *Annals of Surgery*, 1893, xviii, 402.

although the kidneys and ureters become dilated by chronic urethral obstruction (Fig. 55), this dilatation is clinically subordinate to the inflammatory features of the disease.

Ureteral Obstruction.—Ureteral obstruction acts differently. No distensible bladder intervenes to distribute the pressure, and infection is often entirely absent; so that the aseptic dilatation of kidney and ureter progresses rapidly and unobscured.

FIG. 101.—HYDRONEPHROSIS FROM URETERAL COMPRESSION (AT *A*) BY A BRANCH OF THE RENAL VEIN. This obstruction caused an intermittent hydronephrosis, which was permanently cured by the liberation of adhesions and nephropexy.

The ureteral obstructions are:

1. Obstruction from within by stone, tumor, or foreign body (Fig. 84).

2. Pressure from without by aberrant renal vessel (common) (Fig. 101) or by pelvic growth (uncommon).

3. Kinking of the ureter from nephroptosis.

4. Strictures and valves of the ureter, especially those caused by anomalous origin of the duct or by stricture at its termination (p. 586).

Roberts [1] has examined 52 cases in reference to their etiology. Twenty were bilateral and 32 unilateral. The cause was congenital in 20 cases. In 2 of these a supernumary renal artery crossed and compressed the ureter near its origin; in 4 the ureter was congenitally imperforate; in 4 the ureter entered obliquely into the pelvis of the kidney; in 1 the ureter was kinked and adherent; in 1 there was stricture at the vesical extremity. Thirteen of these congenital cases were bilateral. Of these, 2 were still-born, 5 died within six months (3 within forty-eight hours) after birth. Four lived from five and a half to twenty years. One [2] survived to the age of thirty-eight.

Of the 32 cases of acquired hydronephrosis, 11 were due to impacted ureteral calculi (3 others were attributed to the same cause); 5 showed inflammatory or ulcerative stricture; 9 were occluded by external pressure—by peritoneal adhesions (3 cases), gravid uterus, ovarian cyst, cancerous growth.

Among Roberts's cases 25 were male, 23 female.

[1] "Urinary and Renal Diseases." Second American Edition, Philadelphia, 1872, p. 482.

[2] Kinked and adherent ureters, doubtless not congenital.

Morris has analyzed 142 cases, of which 128 were due to obstruction of the ureter, by cancer of the pelvic organs (118), cancer of the abdominal organs (3), ovarian cysts (4), and "constriction of the ureter" (3). Yet hydronephrosis due to cancerous obstruction is rarely noted except postmortem.

The so-called traumatic hydronephrosis is almost always an encysted perinephritic extravasation.

A special cause of hydronephrosis, a cause that figures but rarely in statistics and yet is commonly encountered in practice, is nephroptosis. Since so few movable kidneys become hydronephrotic it is an open question which is the antecedent condition. Certainly renal mobility is associated with practically every case of intermittent hydronephrosis, and I believe that in a great majority of hydronephroses due to kinked and adherent ureters, whether over an aberrant renal vessel or not, and to oblique implantation of the ureter in the kidney pelvis, the first kinking of the ureter or pouching of the pelvis is attributable to a nephroptosis (Fig. 101). Why so small a proportion of movable kidneys becomes hydronephrotic is not clear.

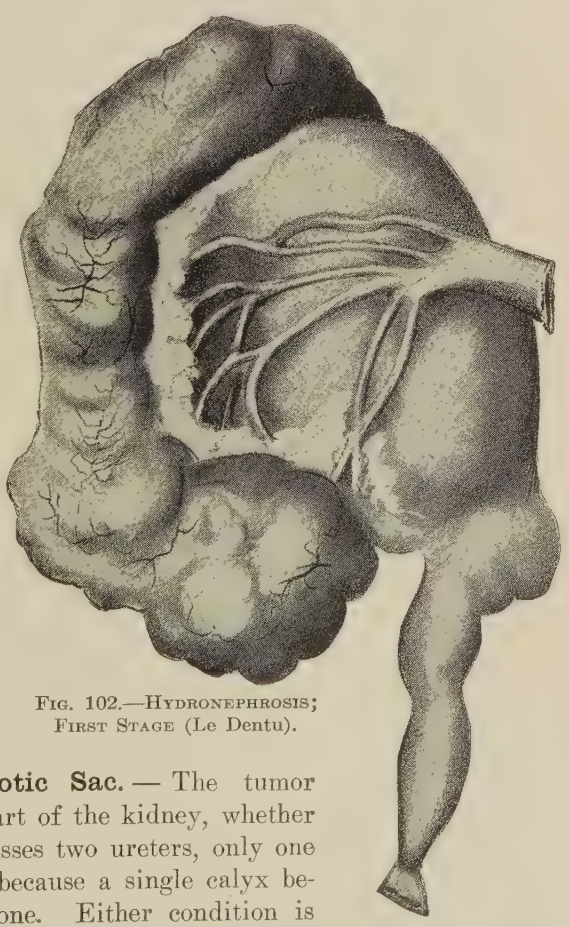

Fig. 102.—Hydronephrosis; First Stage (Le Dentu).

PATHOLOGY

The morbid ureteral conditions at the point of obstruction require no detailed description. The strictures, adhesions, etc., present no peculiar features.

The Hydronephrotic Sac. — The tumor may consist of only a part of the kidney, whether because the kidney possesses two ureters, only one of which is blocked, or because a single calyx becomes occluded by a stone. Either condition is very rare; as a rule, the sac consists of the entire kidney and its pelvis. The ureter may also be dilated.

The size of the tumor varies from that of a normal kidney to that of a child's head.

The sac wall consists of the renal pelvis and capsule. The kidney caps the tumor. The outer surface of the mass is irregularly ovoidal, the inner surface is irregular. If the hydronephrosis is small its interior consists of the dilated pelvis and calices (Fig. 102). If large, it is a great, smooth-walled cavity crossed by fibrous septa representing the

Fig. 103.—Hydronephrosis; Second Stage, the Kidney Substance being completely Atrophied (Le Dentu).

remains of the columns of Bertini (Fig. 103). The sac wall may be thin, but is usually tough and fibrous. Cartilaginous nodules have been observed in it.

Renal Changes.—The changes in the kidney substance are interesting. At first the kidney is congested, the canaliculi dilated, and the

cells flattened. This process soon manifests itself macroscopically by the thinning out of the kidney tissue. Thus the kidney becomes more and more spread out on the surface of the sac with a great portion of its secreting substance atrophied.[1] But this is not the only change. The remaining parenchyma cells—for the kidney is never completely atrophied—undergo a compensatory hypertrophy. They grow to three or four times their normal size and their secretory capacity increases accordingly. It is for this reason that every hydronephrotic kidney should be recognized as a useful, though an impaired, organ, and should not be sacrificed unnecessarily.

The hydronephrotic sac may be open or closed. If the ureter is merely kinked, the hydronephrosis is usually intermittent. If contractured or obstructed, the hydronephrosis is fixed or constant, and the orifice of the sac may finally become absolutely sealed.

The Fluid.—The quantity of fluid in a hydronephrotic sac often reaches 5 or 6 gallons. One case is reported (Glass) containing 30 gallons.

The quality of the fluid varies. A large ancient fixed hydronephrosis usually contains a simple solution of sodium chlorid, though it may contain urea, albumin, urinary crystals, epithelial cells, and leukocytes, and less often blood or cholesterin.

There may be a catarrhal pyelo-nephritis, with slight infection of the contents of the sac (infected hydronephrosis), but this light infection does not materially influence the clinical aspect of the case.

Physiology.—It has long been the generally accepted belief that the hydronephrotic kidney secretes a urine less rich in solids than that of a normal organ; but Guyon and Albarran [2] have shown that even the kidney whose ureter has been occluded for a great while will begin to secrete when the obstruction is removed. Urea appears in the secretion, though it may have been entirely absent from the fluid in the sac; while the quantity of fluid secreted by the diseased organ may exceed that secreted on the sound side. In one case (infected) in which the renal tissue was so compressed that it was only 2 or 3 mm. thick, the kidney excreted a liter a day after the pressure had been removed.

The kidney whose outlet has not been entirely closed acts in a similar manner. While a normal quantity of urine may be excreted by the diseased organ, it is poorer in urea and salts. It usually contains one quarter to one third of the total urea. While the total excretion of urea may vary widely from day to day, this variation takes place almost entirely in the sound kidney, the diseased organ excreting an approximately constant amount.

[1] There is no interstitial sclerosis, no production of fibrous tissue, in simple uninflamed hydronephrosis.

[2] *Guyon's Annales*, 1897, xv, 1200.

SYMPTOMS

Many kidneys found hydronephrotic postmortem give no symptoms during life. The one characteristic symptom by which attention is called to the kidney is the presence of a tumor. There are clinically two varieties of hydronephrosis. When the tumor is constant the hydronephrosis is spoken of as fixed; when the tumor varies in size the hydronephrosis is said to be intermittent.

Fixed Hydronephrosis.—When the hydronephrosis is fixed the patient usually gives a history of a slowly growing *tumor* in his side. Or soreness and *pain* may first call attention to the kidney; but, as a rule, unless the kidney is misplaced and adherent, fixed hydronephrosis is uncomfortable rather than painful. The tumor grows very slowly. It may burst either into the peritoneal cavity or into the perirenal space; either event is rare.

On examination a smooth, elastic, fairly movable, and, as a rule, insensitive tumor is found filling the side. The absence of systemic disturbance is remarkable. There is no fever, and, unless both kidneys are affected, no evidence of renal insufficiency.

Fixed hydronephrosis almost invariably attains palpable dimensions before it is called to the physician's attention.

It is the intermittent hydronephrosis whose sharp, early symptoms demand diagnosis by ureter catheterism and obtain the more delicate examination afforded by this instrument. The fixed hydronephrosis will often not admit the ureter catheter.

Intermittent Hydronephrosis.—This condition presents an entirely different picture. The trouble begins with irregular attacks of severe pain in the side. These pains are habitually attributed to the intestines, to hysteria, or to renal colic. When the patient is examined between attacks the discovery of a movable and tender kidney only confirms the diagnosis of hysteria, and if the patient becomes thin and anemic and has flushes of watery urine, this only adds color to the picture.

But affairs go from bad to worse. The attacks of pain become more and more severe, they recur every few days. During the attack the distended kidney may be felt filling the entire loin. The pain, after lasting several hours or days, is suddenly relieved by the passage of large quantity of urine; but the relief is only temporary. At the end of the usual interval the pain recurs. In a personal case the pains began twenty years before the tumor was found, while in another the tumor reached enormous dimensions after less than ten years' growth.

Morris justly remarks that not all these cases are due to renal mobility, and cites instances attributed to stone and to vesical papilloma. Yet

Terrier and Baudouin, who collected 83 reported cases, showed that the condition was almost always associated with nephroptosis.

The usual outcome of an intermittent hydronephrosis is that it becomes fixed. The variations in size decrease and the pain becomes more constant and less severe.

DIAGNOSIS

It is scarcely possible to mistake a fully developed intermittent hydronephrosis. The large recurrent lumbar tumor is characteristic.

A fixed hydronephrosis may be distinguished as a chronic noninflammatory renal tumor. When large the cystic nature of the growth is obvious. It may then be mistaken for ovarian cyst. When small, it is not always possible to distinguish a hydronephrosis from other tumors of the kidney. The occurrence of hematuria may obscure the diagnosis.

Accurate diagnosis of hydronephrosis is made by the ureter catheter. This instrument supplies a triple test.

1. By withdrawing from the kidney no urine at all or a urine limpid or but slightly purulent, and of relatively inferior quality, it establishes the presence of renal insufficiency as distinguished by the tests described in Chapter VI.

2. When the catheter can be introduced into the renal pelvis, it may draw a large amount of fluid if the pouch happens to be full, or, in any event, it can be employed to measure the content of the kidney pelvis.

To do this a catheter should be introduced into the bladder and the pelvis slowly dilated with sterile water tinged with methylene-blue or argyrol, introduced into the ureter catheter by means of a 10-c.c. hypodermic syringe with a two-way stopcock. As soon as the patient complains of discomfort in the loin the pelvis is estimated as full and the fluid is permitted to run out through the ureter catheter. The bladder catheter is used to note whether any of the injected fluid escapes into the bladder.

Kelly, working exclusively among women with his direct cystoscope, is able to employ very large catheters (No. 8), and thus he almost always escapes leakage. Working among men with smaller catheters, I have not been so fortunate.

3. I have in several instances outlined the pelvis very satisfactorily by injecting a saturated solution of argyrol [1] and immediately submitting the patient to radiography. The advantage of this method is that it not only gives a very fair estimate of the presence of renal dilatation, whether there is extra-catheter leakage or not, but it also shows in some cases the position of the ureteral obstruction.

In order to obtain these results it has not seemed necessary to fill the

[1] *Trans. Am. Urolog. Assoc.*, 1909, vol. iii.

pelvis. Injection of not more than 20 c.c. has almost invariably given a sufficiently accurate shadow. The argyrol is not irritating if freshly prepared.

The results of these injections are illustrated in Fig. 100, and Pl. VI and VII. Estimating that the normal pelvis holds from 5 to 12 c.c. of fluid, we may conclude that: (1) Dilatations of less than 20 c.c. are not shown. (2) Larger dilatations show a pelvis of a characteristic shape, resembling a "derby hat." (3) Ureteral obstruction by adhesion at the lower pole of the kidney is suggested by a curve in the ureter at that point. (4) The normal ureter drops in a straight line from the renal pelvis.

PROGNOSIS

Unless both kidneys are affected hydronephrosis does not threaten life. The development of the tumor is very slow, and treatment is usually demanded for the relief of pain. Infection may occur, transforming the hydronephrosis into an infected hydronephrosis (common), or into a pyonephrosis (rare). Rupture of the sac into the peritoneum —an accident usually fatal—is most exceptional. Rupture into the perirenal space, with the formation there of a false hydronephrosis, may occur. Morris noted the spontaneous and permanent disappearance of 6 or 7 out of 47 hydronephroses observed by him.

TREATMENT

Just as hydronephrosis has been known to disappear spontaneously, so massage and repeated aspirations of the cyst can boast their cures. I can see no advantage in massage, and if the dangers of aspiration are not great neither are its chances of success. Albarran has achieved some cures by the use of the ureter catheter. This has at least the advantage of pretending to straighten out the ureter. But in the majority of cases these palliative measures must fail; there is a definite ureteral obstruction, and until that obstruction is removed the hydronephrosis must persist. Hence the sole treatment in which confidence may be placed is operation.

Operative Measures.—Although a number of plastic operations upon the ureter for the relief of renal retention are described in another chapter, and although some surgeons hope to cure all their cases by this or that operation—by nephrotomy, by nephropexy, or even by nephrectomy [1]—yet the only surgical cure of hydronephrosis is exploration, the object sought being the discovery and relief of the ureteral obstruction,

[1] Thus the Mayos maintain that a hydronephrosis whose content is less than 30 c.c. requires no operation, while one whose content is over 150 c.c. calls for nephrectomy.

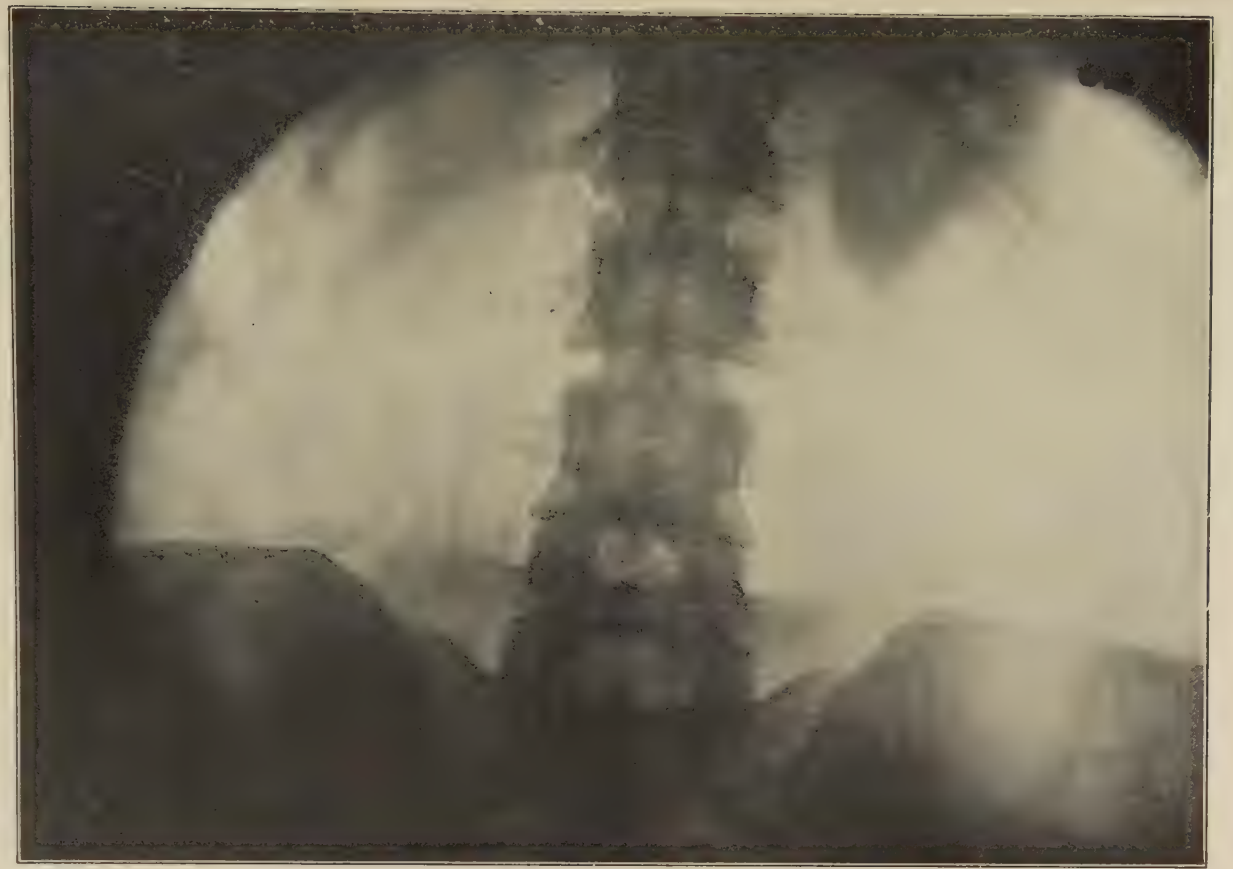

PLATE VII

Infected Hydronephrosis Radiographed after Argyrol Dilatation.

In the lower part of the opposite loin is seen the shadow of a lead-coated ureter catheter.

or nephrectomy, if the obstacle cannot be relieved, or if the kidney is deemed worthless.

When the hydronephrosis is intermittent, it may be fairly presumed that its cause is a nephroptosis, and that nephropexy, preceded by the loosening of adhesions, will effect a cure. The usual lumbar incision reveals the distended kidney. If the tumor is so large as to encumber the operative field, its contents are drained through a small incision, preferably in the pelvis.[1] Then the kidney is forced upward under the ribs and its pelvis carefully freed of adhesions by blunt dissection until the ureter is reached; here the kink will usually be found. The adhesions must be carefully separated. When the obstruction is apparently relieved, the patency of the duct should be tested by passing a ureteral catheter from the pelvis of the kidney into the bladder.

In other cases, an impacted stone, a ureteral stricture, or external pressure will be found to cause the obstruction (p. 500). While the operative technic must differ with each case, it may be said in general that—

1. The discovery and removal of the obstruction is the first object of the operation.

2. Until the ureteral catheter has been passed from the pelvis of the kidney down and into the bladder one cannot feel sure that the obstacle has been removed.

3. No matter how dilated the kidney, it is still of some service to the patient, and should not be extirpated unless nephrectomy is considered a less formidable procedure than the removal of the obstruction.

4. Operating to preserve the kidney does not imply the performance of any of the so-called conservative plastic operations for renal retention. Simple nephropexy, or even nephrotomy, is a far safer and, in all but the exceptional cases of ureteral valves and strictures, an equally certain procedure.

5. Yet, to return to the original point, the ease with which certain cases may be cured is no excuse for overlooking the obstructive cause of the retention, since, unless this cause is known, we have no means of judging how much relief may be expected from the operation.

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[1] The line of incision should radiate from the neck of the pelvis.

CHAPTER XLVII

PHYSIOLOGY AND VARIOUS DISEASES OF THE BLADDER

PHYSIOLOGY

Capacity.—The capacity of the bladder is physiological, not anatomical (Guyon). Although in actual size the healthy bladders of different individuals do not differ materially, the actual capacity of the organ depends upon its sensitiveness, and this sensitiveness varies at different times and with different individuals. The physiological capacity of the bladder, the amount of urine an ordinary bladder holds when the desire to urinate is first felt, is about 250 c.c. (8 ounces).

Sensitiveness.—The healthy bladder is quite insensitive to touch, but very sensitive to tension. Thus a sound may be poked about in the bladder and cause no sensation whatever except in the prostatic urethra. On the other hand, the torture of "holding water" requires no comment. The sensitiveness of the bladder may be diminished by habit; beer-guzzlers and diabetics may not urinate more often than those who pass perhaps only half as much urine. The sensitiveness is, on the other hand, increased by nervousness and by inflammation.

Absorption.—Although the point is disputed, it is probable that the mucous membrane of the healthy bladder is practically as impervious as the skin. But fluids are rapidly absorbed through the mucous membrane of the posterior urethra, and also through the bladder epithelium when inflamed.

Contraction: Urination.—"Man urinates with his bladder, not with his urethra," says Guyon; but, though all are agreed thus far, there are diverse explanations of the mechanism of urination. (Cf. Rehfisch,[1] Ultzmann,[2] Guyon,[3] Versari.[4]) The known facts upon which we may depend are: 1. The vesical sensitiveness to tension. 2. The more marked sensitiveness of the posterior urethra, and the desire to urinate and the sensation of urination provoked by passing an instrument into it. 3. The presence of only one voluntary muscle to guard the outlet—viz., the

[1] *Virchow's Archiv*, 1897, cl, 111.

[2] *Deutsche Chir., v. Billroth u. Lücke*, 1890, lii, 8.

[3] "Leçons cliniques," 1ière édition, 1896, ii, 379.

[4] *Op. cit.*

external sphincter or cut-off muscle. 4. The incontinence of urine that results from distortion of or injury to the internal sphincter. Upon these may be built up the following plausible theory: The internal sphincter is the true guardian of the bladder. It remains closed, or at least sufficiently contracted to keep the urine out of the prostatic urethra while the bladder slowly fills. When the bladder has become distended to its physiological capacity the desire to urinate is felt, the bladder begins to contract, and, by means of a reflex carried out in the lumbar portion of the cord and comparable to similar reflexes in the other hollow viscera, as it contracts its sphincter opens and the urine penetrates the posterior urethra. A sharper desire to urinate is felt, and if this is acceded to by voluntary relaxation of the external sphincter, the bladder slowly contracts and empties its contents through the open channel, the last drops being ejaculated by the piston-stroke spasm of the deep urethra, or the stream cut off by a sharp contraction of the voluntary muscle. But if the desire to urinate is not acceded to, the outflow of urine is prevented by a conscious, voluntary contraction of the external sphincter and the desire for a time passes over, perhaps because the internal sphincter closes again, drives the few drops back into the bladder, and holds out a while longer. Then the desire returns, each time more imperiously, until it is satisfied.

INCONTINENCE OF URINE

Incontinence of urine, or enuresis, is that condition in which the urine flows involuntarily out of the bladder as soon as it flows in. Incontinence must be distinguished from overflow. In each instance there is a continual involuntary dribbling; but in the one case the bladder is empty, in the other it is full. Enuresis shows that the vessel leaks; overflow shows that the outflow pipe is obstructed. In the adult male dribbling of urine almost always signifies overflow. With true incontinence the urine flows away without any pain or desire to urinate. Imperative urination, when the inflamed bladder contracts every few minutes with a force that the cut-off muscle cannot oppose, is often spoken of as false incontinence.

Incontinence may be partial or complete, diurnal or nocturnal.

Incontinence in Adult Males.—Stagnation with overflow and false incontinence have been already considered. True incontinence depends upon—

1. Asymmetrical hypertrophy of the prostate, where, after the collection of a little urine, the rest trickles away, there being no distention of the bladder. I have never seen such a condition.

2. Postoperative enuresis, resulting from overcutting the internal vesical sphincter.

3. Paralysis of the bladder.
4. Tuberculosis of the neck of the bladder.
5. Persistence of infantile incontinence.

Incontinence in Adult Females.—Women have weaker bladder sphincters than men, and among them such lesser irritations as uterine displacements, the pressure of tumors, and even slight, temporary cystitis, may excite a most persistent and annoying incontinence of urine.

ENURESIS OF CHILDHOOD

Infants have little or no control over their urination, especially at night, but after they leave off diapers they are expected to stop wetting the bed. There are doubtless few children who fulfill this expectation entirely. Up to the age of five or six an occasional accident may occur to the most normal child. But this is not enuresis. The true nocturnal enuresis of children—for it is only exceptionally diurnal—is not noticed, as a rule, until the child is five or six years old. Then he begins to wet his bed quite regularly, perhaps two or three times every night. He may also lose his urine involuntarily by day, and very rarely the incontinence occurs only by day and not by night.

Etiology.—While the enuresis of childhood may be symptomatic, it is usually idiopathic. Symptomatic incontinence may be due to tuberculosis or stone of the bladder, or to spinal disease, or it may be a reflex disturbance aroused by congenital stricture, by tight or adherent prepuce, etc. But the majority of cases are idiopathic, and due to a neurotic taint. Such children are, as a rule, shy, overgrown, pale creatures. They are often intelligent and given to quiet reading rather than to boisterous play. The tendency to enuresis often runs through the whole family, and the elders may show other neuroses. Even symptomatic cases often show a neurotic element.

Prognosis.—The prognosis of idiopathic enuresis is good. Even the most persistent cases recover spontaneously at the advent of puberty, so that while nothing is more common than enuresis in a child, nothing is more unusual than enuresis in an adult.

Treatment.—Symptomatic incontinence may be eliminated by a thorough examination of the urine, the prepuce, and the meatus, and an exploration of the urethra. The child's habits should be inquired into with an eye to indolence, masturbation, and mental overexertion. Adenoids and enlarged tonsils should be removed.

Life in the open air, with plenty of exercise and not overmuch study, must be insisted upon. Good habits should be encouraged by awakening the child to pass water late at night and early in the morning, using moral suasion, and avoiding the use of fluids toward evening.

Besides these means, absolute benefit may be expected from bella-

donna, commencing at a small dose, perhaps $\frac{1}{10}$ of a grain of the extract, if the child is very young, and increasing gradually until some of the poisonous effects of the drug are noticed. A tonic of strychnin and iron may be useful. Guyon considers faradization quite specific when the urethral muscles are relaxed. He places one electrode in the membranous urethra, the other over the pubes. If the deep urethra is hyperesthetic (which is unusual) instillations of nitrate of silver will do good. Stumpf has obtained good results by making the child sleep with its head low and its pelvis elevated. Phillips gives antipyrin and arsenic. Perlis reports 156 cases treated with rhus aromatica. He employs the fluid extract and in some cases increases the daily dose to gtt. lxxx. Recovery occurred in 102 cases. Thirteen were unimproved.

As an aid to training the child to recognize the call of nature, Chetwood's urethral clip may be applied each night. This prevents urination until it is removed.

Cathelin's suggestion to inject salt solution into the sacral canal and Sonnenberg's modification of it—i. e., injection of salt solution into the cellular tissues behind the rectum—have not proven generally helpful.

Time and health and training form the backbone of the cure.

POST-PROSTATECTOMY ENURESIS

Incontinence of urine is one of the most annoying sequelæ of perineal prostatectomy. Its cause is most obscure, witness the following facts:

1. It does not follow perineal section for stricture, even though the membranous urethra is divided from end to end.

2. It does not follow suprapubic prostatectomy, even though the internal sphincter is freely divided and the whole prostatic urethra torn away.

3. It does follow Bottini's operation, which divides only the internal sphincter.

4. It is about equally frequent after Chetwood's operation and perineal prostatectomy.

5. It occurs as often after simple operations as after complex and destructive ones.

Doubtless, therefore, the physical basis of incontinence is operative disturbance of any part of the sphincteric mechanism, and doubtless, too, there is a subjective element in it. Some are incontinent by day, others by night, and, as a rule, they may be somewhat benefited by suggestion.

Treatment.—Incontinence during the first weeks after operation is unimportant. The patient should be reassured and a complete cure hoped for. But if the incontinence persists much good may be done by filling the bladder with an unirritating solution and then training the

patient by bidding him "Start—stop—start—stop," until the bladder is empty. Dr. Alexander has achieved excellent results by this method.

For some cases the urethral clip is helpful. Of the many operations that have been suggested none has proven serviceable.

PARALYSIS OF THE BLADDER

As atony is common, so is true paralysis of the bladder rare. It may be caused by many lesions of the nervous system, but is seen most commonly in myelitis and tabes. The paralysis may come on suddenly or gradually. It may affect the body of the viscus alone and cause retention, or the sphincters as well, causing incontinence. The latter condition is relatively rare.

Infection soon ensues and ascends to the kidney. The results, both pathologic and symptomatic, are those of retention cystitis, as in prostatic hypertrophy.

Treatment.—The treatment of the paralysis itself is usually *nil.* But every care should be taken by means of aseptic, systematic catheterism, bladder washes, and the administration of urinary antiseptics, to control the infection as well as may be. Under such a careful *régime* many tabetics do surprisingly well. I have known one to regain the power of emptying his bladder.

When complications, such as intractable stricture or prostatic abscess, require perineal section, a Chetwood operation may sometimes relieve retention,[1] though there is grave danger of adding enuresis to the patient's other woes.

HERNIA OF THE BLADDER (CYSTOCELE)

Cystocele is scarcely recognizable except during herniotomy, and its whole clinical interest centers on the diagnosis of the condition before the bladder is injured by the knife, and on its remedies in case it is so injured.

Abdominal, inguinal (scrotal, sometimes on both sides), crural, perineal, and ischiatic cystocele, and cystocele through the foramen ovale (Lentin), have been noted. In women vaginal cystocele and femoral cystocele are most common; in men, inguinal. Thus, among 22 femoral cystoceles collected by Gibson,[2] 16 occurred in women, while 70 among his 77 cases of inguinal cystocele occurred in men. Lotheissen[3] collected 113 cases of inguinal cystocele in men and only 11 in women. He believes that cystocele occurs in 3 per cent of all inguinal herniæ, although the usual estimate is from 1 per cent to 2 per cent. Inguinal

[1] *Trans. First Internat. Urolog. Congress*, 1908. [2] *Med. Record*, 1897, li, 401.
[3] *Brüns Beiträge*, 1898, xx, 727.

cystocele is extraperitoneal in 69.2 per cent of cases, paraperitoneal ("mixed") in 24.2 per cent, and intraperitoneal in only 6.6 per cent. As extraperitoneal cystocele is met with only in direct inguinal herniæ, it is in this class of cases that cystocele is to be especially looked for.

Cystocele is especially common between the ages of thirty and sixty. Its pathogenesis, depending partly upon the hernial traction, partly upon dilatation of the bladder, has been studied by Lotheissen, Lambret,[1] Cheesman,[2] and Alessandri.[3]

Diagnosis.—The diagnosis is rarely made before operation. The suspected presence of cystocele is verified by the introduction of a sound into the bladder.

Treatment.—The proper treatment of cystocele is herniotomy. If the cystocele is extraperitoneal, it may not be easy to close the abdominal wall firmly over it. Unintentional incision of the bladder during herniotomy is rather a grave complication. Lotheissen collected 65 such cases with 18 deaths. If the condition of the patient permits, the bladder should be closed by one or two layers of Lembert sutures, the efficacy of the line of suture tested by the intravesical injection, and the radical cure completed. At the end of the operation a catheter should be tied into the urethra. If the patient's condition does not warrant the delay necessary to accomplish a satisfactory suture of the bladder, the organ may be fixed in the external wound and permitted to heal after the manner of a suprapubic cystotomy wound.

INTESTINAL FISTULA

Vesico-intestinal fistula may be traumatic, ulcerative, cancerous, tubercular, or congenital. Congenital fistula is very rare. Ninety-five reported cases of acquired vesico-intestinal fistula in man have been collected by Chavannaz.[4] Of these, 13 were traumatic, 29 ulcerative (from stone, abscess, etc.), 19 cancerous, 7 tubercular, and 27 unclassified. The fistula usually opens into the rectum (43 cases) or into the sigmoid flexure (14 cases), but it may open into almost any part of the intestine, even the appendix vermiformis. The fistula may be short and direct, but in fully 25 per cent of the cases there is an intermediate suppurating cavity between the vesical and the intestinal orifice.

Symptoms.—The most notable symptom of vesico-intestinal fistula is the passage of gas from the urethra (*pneumaturia*). This symptom is always present and is always noted by the patient. The urine may also be passed partly or wholly by the bowel, and, when the opening is

[1] *Bull. méd.*, 1899, xiii, i, 397. [2] *Med. Record*, 1901, lix, 985.
[3] *Guyon's Annales*, 1901, xix, 25, 153, and 325.
[4] *Ibid.*, 1897, xv, 1176, 1287, and 1898, xvi, 85, 203.

large, feces may enter the bladder and issue with the urine. Cystitis is inevitable.

Diagnosis.—As a rule, the diagnosis may be made from the presence of pneumaturia, although gas may be evolved by fermentation within the bladder itself. Thus the intravesical action of the yeast fungus upon saccharine urine has been known to cause pneumaturia, and I have seen two obscure cases in which the presence of gas could not be accounted for. If the evidences of bladder disease do not sufficiently confirm the diagnosis of fistula, an injection of methylene-blue solution into the bladder will decide the question by transuding through the fistula and appearing in the dejecta. The position of the fistula may be estimated by cystoscopy, by rectal touch, or by the rectal speculum.

Prognosis.—The prognosis depends on the nature of the fistula. Traumatic fistulæ often heal spontaneously if the bladder is kept clean and the urethra clear. Tubercular and malignant fistulæ will not heal.

Treatment.—Palliative treatment consists of daily irrigation of the bladder and bowel. Traumatic and ulcerative fistulæ that do not heal kindly may be stimulated by rectal injections of alcohol. Palliative operation consists in colostomy. This is the only appropriate treatment for incurable fistula. Temporary colostomy is also employed as a preliminary to the attempt at radical cure. Palliative colostomy has been performed 11 times. Seven patients survived the operation one month; but of these, only 4 lived out the year and only 2 survived three years.

A radical cure may be attempted in several ways. Chavannaz reports three cures by dilating the fistula and scraping its rectal extremity. Suprapubic section and suture of the vesical end of the fistula improved one case. Inasmuch as fistulæ between the bladder and intestine above the rectum are almost all either tubercular or malignant, they are only susceptible of palliation by colostomy. Vesico-rectal fistulæ may be operated upon by the methods employed in the treatment of urethro-rectal fistulæ.

CHAPTER XLVIII

DISEASES PECULIAR TO THE FEMALE BLADDER

By Dr. B. S. Barringer

There exist certain pathological conditions peculiar to the female bladder. These conditions frequently result from disease of the adnexa or from childbirth, and, with the exception of bladder neuroses, are either caused by changes in conformation or circulatory changes in the bladder.

CHANGES IN CONFORMATION

As in the male bladder, there are certain changes in the conformation of the female bladder, the result of pathological processes, which are peculiar to this viscus. These changes in conformation most frequently affect the trigone—the most constantly fixed portion of the entire bladder. And because the trigone contains the internal urethral and the two ureteral orifices, these changes immediately assume importance in the diagnosis of many bladder conditions. If the trigone be distorted the landmarks of the ureteral orifices may be changed. Also, interference with the normal excretion of urine from the bladder with any of its attendant complications may arise.

In the male, prostatic enlargement is the one important cause of distortion of the trigone. Other causes are extremely rare. In the female, because of the proximity of the cervix uteri and vagina, changes in conformation result from pathological conditions of these organs, malpositions, tumor formations, etc.; or from childbirth, as, for example, cystocele.

CHANGES IN BLOOD SUPPLY

The vascular supply of the bladder is roughly distributed as follows—I quote Kelly ("Operative Gynecology," 1897, Vol. I, p. 65): "The superior vesical arteries are distributed over the superior and lateral regions of the bladder. The middle vesical arteries are distributed over the posterior portion, which lies in relation to the uterus and upper vagina. The inferior vesical arteries are distributed to the trigonum

and the middle part of the vagina." The inferior vesical artery in women is a branch of the vaginal artery. Branches of the uterine artery are also distributed to the bladder. The veins follow the arteries and the inferior vesical veins are a part of the vaginal plexus.

Because of this close relation between the inferior vesical and vaginal vessels, changes in these latter, stasis of flow by inflammatory processes, tumor formation, etc., affects the vascular supply of the bladder and may produce a like stasis in these vessels.

Besides this change a stasis may be produced by mechanical pressure of, for example, an acutely anteflexed uterus or a uterine tumor (Pl. I).

Similar conditions of stasis in the male bladder are very rare.

EFFECT OF POSITION OF THE UTERUS UPON THE BLADDER

The normal relations of the bladder to the vagina and uterus are: "The trigonum and a broad strip of tissue extending back from it lies in close relation to the anterior vaginal wall—*the vaginal area* of the bladder. Just above the vaginal area is a narrow strip in close relation to the anterior portion of the supravaginal uterus, as far up as the internal os, *the uterine area*. . . . When the bladder is distended with air it forms a hollow sphere, flattened anteroposteriorly. . . ." (Kelly, *loc. cit.*, Vol. I, p. 271.)

To observe the effect of various positions of the uterus upon the bladder, the bladder is always filled *to its capacity*. When it is so filled distortion of different positions of the bladder by pressure of bodies from without may be easily seen. Normally, the up-and-down mobility of the cystoscope in the female urethra is through an arc of about 90°, and the general trend of the urethra is very slightly upward. This is when the patient is in the dorsal semirecumbent position.

Normal Position of the Uterus.—The normal anteflexed uterus makes a slight depression in the posterior bladder wall. This depression is difficult to see with the prismatic cystoscope. If the uterus be acutely anteflexed this depression becomes more prominent.

Pregnancy or Tumors of the Uterine Body.—As the uterus becomes larger with, e. g., pregnancy, this depression becomes very apparent, and with the growth of the uterus rises in the bladder until it is seen in the bladder vault. The picture (Pl. I) shows this depression in the bladder vault. It is the cystoscopic picture caused by a suprapubic sarcoma arising from a retained testicle. A three- or four-months' pregnancy in the female would give, if the uterus be anteflexed, exactly the same picture. The normal blood-vessels indicate that there is probably no adhesion of the tumor to the bladder, and is of much importance in diagnosis.

Retroflexion.—Acute retroflexion of the uterus gives, in a less degree, changes in the bladder similar to those seen with advanced carcinoma of the cervix. That is, the trigone is raised, the trend of the urethra is changed, and the mobility of the cystoscope in the urethra is somewhat restricted. The optical portion of the cystoscope often has to be markedly depressed to bring the trigone and urethra in sight.

In these conditions, cystoscopy naturally does not give as adequate an idea of the various positions of the uterus as does vaginal palpation. A knowledge of the cystoscopic changes is, however, necessary, when a bladder is examined, to prevent errors of diagnosis.

DISEASES OF THE BLADDER

Cystocele.—Cystocele in women has many points of similarity to prostatic enlargement in man. In both the trigone is distorted. In the former the trigone, with the ureteral orifices, may be entirely contained in the pouch of the cystocele. All landmarks of the base of the bladder are lost (Pl. I). The interureteral ridge is practically destroyed, and much difficulty may be experienced in finding the ureters.

In prostatic enlargement the trigone may be pushed upward or to one side; in the cystoscopic examination the position of the interureteral ridge may be taken by the median lobe of the prostate (Pl. III), and rarely the ureters are entirely obscured.

In both residual urine may occur, even to complete retention. Penrose [1] says: "In a case of cystocele residual urine often remains in the pouch of the bladder wall. In some cases the woman learns that, in order to empty the bladder, it is necessary for her to push the cystocele upward and forward at every act of urination."

In both prostatic enlargement and cystocele circulatory disturbances may cause night frequency of urination as a prominent symptom. And in both we may have, as a result of the strain to empty the bladder, a trabeculated bladder; and as a result of the retention, cystitis and its complications.

This symptom-complex, which may all be due to a cystocele, is not, I believe, generally recognized.

Parturition is accepted as the most frequent cause of cystocele.

Other causes exist, however, as in the case below quoted. This patient had had neither a child nor a miscarriage, yet she had a well-defined cystocele resulting probably from coitus.

Aside from the symptoms that cystocele may give rise to, there are two points which I wish to emphasize. First, the pouching of the bladder wall in the vagina may not indicate as well as the cystoscopic ex-

[1] "Text-book of Diseases of Women," 1898, p. 85.

amination the extent of the cystocele. Second, in catheterizing such cases the same precautions should be taken as in catheterizing a prostatic.

Case I.—Mrs. M. S., aged fifty years. History: No children; no miscarriages. For past three years has had painful and frequent micturition, intermittently, lasting three to four days and then stopping. Night frequency nine to ten times and moderate day frequency. Pain through hypogastrium at these periods. Never hematuria.

Examination.—Well-marked pouching forward of anterior vaginal wall.

Uterus normal in position.

Cystoscopy.—Urine clear. Residual not tested.

Marked falling of trigone. Trigone and ureters in a moderate-sized pouch. Bladder mucous membrane and ureteral orifices normal.

A pessary was fitted to this case to correct the cystocele and a certain amount of relief was experienced, the patient urinating but three to four times at night, and five to six times by day.

This patient was advised to have the cystocele operated upon and was sent to a gynecologist for this purpose. When waiting in the hospital she contracted a cystitis, having been catheterized, and the surgeon refused to operate, believing that all of her symptoms were caused by the cystitis. Since then the patient's symptoms have continued, notwithstanding the clearing up of the cystitis.

This emphasizes the importance of an accurate diagnosis in these cases, and how even the gynecologist may fail to recognize the condition.

The improvement of symptoms when the pessary was used is, I think, significant.

Carcinoma of the Cervix.—When a carcinoma of the cervix uteri invades the anterior or lateral vaginal walls, the most accurate means of ascertaining the condition of the vesicovaginal septum is by means of the cystoscopic examination. The cystoscopic examination "becomes progressively more important as the growth extends, and the nearer it approaches the borderland between operative and nonoperative."

When the carcinoma approaches and invades the vesicovaginal septum it interferes with the blood supply of the bladder, particularly in those portions supplied by the middle and inferior vesical vessels. And cystoscopically we have bladder pictures of all grades of venous stasis (Pl. I).

A number of these bladder alterations are similar to those occurring with vesical or perivesical inflammations, and care must be taken in distinguishing between the two. The differentiation can, however, practically always be made.

The cystoscopic examination includes:

(*A*) Estimation of the direction of the urethra and the position of the trigone, marked elevation of the trigone meaning inoperable carcinoma.

(*B*) Conditions within the bladder:

(1) Tumor masses encroaching upon or causing retraction of the bladder.

(2) The alterations of the bladder which are similar to those occurring with vesical or paravesical inflammations. These are (*a*) folding and swelling of the bladder mucous membrane, (*b*) varicosities of the bladder vessels, (*c*) submucous hemorrhages, (*d*) congestion of the bladder, (*e*) cystitis, (*f*) bullous edema. The most important among these conditions within the bladder which indicate involvement of the vesico-vaginal septum are: Tumor masses encroaching upon or causing retraction of the bladder; folding and swelling of the bladder mucous membrane; marked varicosities.

(3) Those alterations which are unquestionably caused by the carcinoma. Alone under this head stands carcinoma of the bladder.

Bladder Neuroses.—A true bladder neurosis is one in which, with our present methods of diagnosis, no causative pathological condition of the bladder can be recognized. Or if there is a definite cause and this cause be removed, and the bladder symptoms nevertheless persist, this is also a true neurosis.

Bladder neuroses can be divided into three classes: *First,* those in which there is a definite nerve lesion causing the neurosis, as in tabes dorsalis. *Second,* those in which the nerve lesion is not definitely known —as when we have bladder disturbances in a neurasthenic or hysterical patient. *Third,* those in which the bladder disturbance is caused reflexly, as in a rectal carcinoma or disease of the pelvic organs.

In these two classes the bladder must either be normal, or, if diseased, the disease must be caused by the neurosis, to call the pathological condition a true neurosis. For example, in a tabetic patient there may be certain local bladder conditions, enlarged prostate, etc., which cause the bladder symptoms which we wrongly ascribe to the tabes. On the other hand, we may have a bladder neurosis with bladder changes, trabeculated bladder, etc., caused by the tabes.

Opposed to this we not infrequently see some local bladder condition causing bladder symptoms which in turn cause general neurasthenia. I have lately seen such a case where, upon the removal of a foreign body from the bladder, all the symptoms of neurasthenia ceased.

These conditions are seen alike in men and women. The general

symptomatology of bladder neuroses is classified by von Frankl-Hochwart [1] as follows:

1. The Sensory Anomalies.
   A. Pain.
   B. Anomalies of urination.
      a. Increase.
      b. Decrease.
2. Dysuria.
3. Urinary Retention.
4. Incontinence.

Pain.—Under the heading of *nervous bladder pain* Frankl-Hochwart makes the following important statement, which is confirmed by my few observations, that " in a normal bladder, pain as a nervous symptom is very rare; and such a diagnosis should be made only with the greatest care. . . ." The true nervous bladder pain may be caused by rectal conditions, diseases of the pelvic organs, or kidneys, or ureters. On the other hand, the bladder pain may be caused by localized bladder conditions, cystitis, stone, and others.

Increased or Decreased Urination.—What has been said of nervous bladder pain is also true of these anomalies of urination. I have a number of times seen a diagnosis of incontinence made when the patient had a paralyzed bladder full of urine, and the frequency came from overflow. Lately my attention has been called to two cases of chronic appendicitis in women causing frequent urination, which ceased upon removal of the diseased appendix. In one of these cases there were adhesions between the appendix and bladder.

Dysuria.—By nervous dysuria is understood " difficulty in emptying the bladder in spite of the absence of a direct anatomical obstacle." The nervous dysuria may be caused by enlarged prostate tumors of the adnexa, hemorrhoids and other rectal diseases, intoxication with turpentine, etc. (mentioned by Frankl-Hochwart), following abdominal operations, and in spinal diseases, neurasthenia, and hysteria. A true dysuria may be caused by urethral stricture, enlarged prostate, bladder stone, cystocele, malpositions of the uterus, pregnancy.

Retention and Incontinence.—These are less frequent manifestations. The retention is likely to be complete, the incontinence incomplete.

ALTERATIONS IN THE BLADDER

The two principal alterations of the bladder caused by the bladder neuroses are cystitis and trabeculated bladder. When either or both of these are present the diagnosis of a true neurosis is made doubly dif-

[1] "Handbuch der Urologie," 1905, vol. ii, p. 795.

ficult. And different opinions as to the underlying cause of trabeculated bladder increase this difficulty.

If trabeculated bladder is considered to be due to interference with the excretion of urine from the bladder, then the causes in women to be excluded are comparatively few. Cystocele, urethral stricture, pressure from a retroflexed uterus or a tumor or the cervix may hinder the excretion of urine, and if any of these be present it is probable that the diagnosis of a neurotic bladder neurosis cannot be made. Knoor says: "Tabes is most frequently the cause of trabeculated bladder in women. It is caused by a spastic stricture of the sphincter, so that emptying the bladder is much hindered." I have seen a case which Zuckerkandl said was caused by trauma to the bladder nerves during an instrumental delivery.

If, on the other hand, the trabeculated bladder is thought to be caused primarily by inflammation, it is self-evident that the diagnosis of a bladder neurosis becomes still more complicated.

The following case illustrates the care which must be taken in seeking the cause of a bladder neurosis, and that after the original cause is removed the patient may be still left with a true neurosis.

R. F., aged forty years, married, two children. For some years previous to when first seen (1905) the patient had had painful and frequent urination, arising at night from ten to twenty times and by day about every half hour. She had been under Zuckerkandl's (Vienna) care; had been examined by him under ether; had been given an exhaustive gynecological examination; and had been diagnosed as bladder neurosis. All kinds of treatments were tried upon her with no success. When I saw her I found that she had a left unilateral nephritis (Luys separator used); no urinary tuberculosis by injection of a guinea pig. A cursory vaginal examination revealed nothing, and a cystoscopic examination a congested bladder base. Intermittent treatment for two years, stretching the sphincter under ether, etc., did no good. About a year ago the patient had menorrhagia and metrorrhagia. Examination six months later revealed a fibroma of the anterior uterine wall which pressed upon the bladder and markedly diminished its capacity. Hysterectomy gave some improvement in the bladder symptoms, which soon, however, relapsed. There is nothing left to advise other than Christian Science or a vesico-vaginal fistula. I think that this uterine fibroma, three or four years before it was discovered, was the cause of the neurotic bladder, probably causing either a circulatory or a nervous disturbance.

Treatment.—Careful search in many cases will reveal some small anomaly, which, if corrected, will cure the patient. As, for instance, I have seen a case in which stretching a stricture of the female urethra, and incidentally the bladder sphincter, resulted in an immediate cure.

In many cases there is an intense hyperemia or even cystic condition of the trigone caused by the pollakiuria. In these cases there is often irritability of the sphincter, or "sphincter cramp," which apparently causes the neuroses. If this be overcome a brilliant cure often results. The following case illustrates this:

Mrs. P., aged forty-six years; six years ago had her first child—a breach delivery with impacted head. Following the delivery, had to be frequently catheterized. From that time to now the patient has had partial incontinence; at times a constant dribbling, and at other times involuntary urination on the slightest exertion. She has constantly worn a napkin.

Examination revealed nothing but a prolapsed urethra. Cystoscopically an entirely normal bladder, with the exception of a bullous condition of the trigone. Following the cystoscopic examination the symptoms were almost entirely relieved, the slight stretching of a 24 F. instrument evidently overcoming the irritability of the sphincter.

In cases of retention, systematic emptying of the bladder, possibly gradual stretching of the sphincter, etc., are indicated. Electrotherapy, hydrotherapy, and even operative interference (vesico-vaginal fistula) may be indicated in cases in which instrumental methods fail.

CHAPTER XLIX

IDIOPATHIC RENAL HEMATURIA—VARICOSE VEINS OF THE BLADDER

IDIOPATHIC OR ESSENTIAL RENAL HEMATURIA

When a hemorrhage occurs in the kidneys its outward sign is hematuria. The only condition in which a serious hemorrhage can occur without hematuria is rupture of the kidney, when, as has already been remarked, the blood effused into the lumbar recess or into the perirenal cavity is of far more importance than the relatively small amount that escapes down the ureter. Apart from this condition, renal hemorrhage is expressed by hematuria.

The hematuria that occurs with tumor of the kidney is at once the most important and the most profuse spontaneous hemorrhage from that organ. Bleeding is also a common symptom of renal stone and renal tuberculosis; and when the kidney bleeds, one of these three conditions —stone, tubercle, or tumor—is usually suspected. But there are a great many other diseases, a few of them surgical in their aspects and most of them medical, in which renal hemorrhage—even profuse renal hemorrhage—may occur. To such profuse hemorrhage from an obscure cause has been given the name of essential or idiopathic renal hematuria.

Etiology.—The causes to which this essential renal hematuria has been attributed may be classified as follows:

1. Hematuria, scurvy, purpura.
2. Drug-poisoning (turpentine, cantharides, etc.).
3. Parasites (e. g., distoma hematobium).
4. Acute or chronic febrile diseases (scarlet fever, malaria).
5. Surgical diseases (hydronephrosis, renal mobility).
6. The passage of urinary crystals.
7. Angioneurosis.
8. Chronic nephritis.
9. Papillary varicosity.

It is not necessary to consider all these conditions in detail. Distoma, for instance, is practically never heard of in these latitudes. Renal hemorrhage caused by drugs or occurring in the course of one of the bleeding diseases has no surgical interest. There remain the hema-

turia due to surgical causes, to angioneurosis, to chronic nephritis, and to papillary varicosities. It is possible that any of these causes may produce a profuse renal hemorrhage. Physical examination of the loins should eliminate hydronephrosis and movable kidney, and there are left for our consideration only angioneurosis, chronic nephritis, and papillary varicosity.

That hematuria may be due to chronic nephritis requires no proof. Examples are commonplace. But such examples, representing a hemorrhage—even a profuse hemorrhage or a series of such—in the course of an acute or active nephritis have no peculiar surgical interest.

What we need to know is whether a prolonged, profuse hemorrhage may result from chronic nephritis in the absence of any other sign of this inflammation.

Up to 1895, or thereabouts, the question was answered mainly in the negative. All cases of otherwise inexplicable profuse or persistent hematuria were attributed to a theoretical angioneurosis. But in the following decade many nephrectomies performed for this condition revealed, almost constantly, either parenchymatous or interstitial nephritis, which had given no symptoms or urinary signs other than the bleeding. In spite of the fact that the bleeding point was not found, the so-called idiopathic hematuria was therefore attributed to nephritis.

But as early as 1898 the bleeding point was found in three cases to be due to oozing from varicose veins of a renal papilla. Fenwick [1] has reported six such cases, Hugh Cabot [2] has added another, and now that the attention of the profession has been called to the renal papillæ as the probable source of bleeding, it seems quite possible that the future will prove most cases of "idiopathic" renal hematuria to be due to this cause.

The affected papilla looks red or purple and "spongy." Section demonstrates the varicosities.

Symptoms and Diagnosis.—There is but one symptom—viz., profuse hematuria. This may be constant or intermittent. It is rarely sufficiently severe to cause anemia.

The bleeding may last a few hours or it may continue for days; having once occurred it may never appear again; or it may return time after time, and be so profuse as to threaten the patient's life. In the presence of a condition so various in its manifestations, so comparable in its only symptom to the most serious affections of the kidney, so dangerous sometimes in its continuance, a diagnosis is of the utmost importance, and a diagnosis is difficult to obtain. Full realization of the fact that the bleeding, which is so often the first symptom of malig-

[1] "Clinical Cystoscopy," London, 1904.

[2] *Trans. Am. Ass'n Gen.-Urin. Surgeons*, 1908, iii.

nant growth in the kidney, may occur two, three, or even five years before any other symptom, cannot fail to impress upon the surgeon the necessity for the utmost caution in deciding the nature of the malady. It is not sufficient that the hemorrhage cease. This it may do spontaneously or as the result of the administration of some drug. But the patient should be warned that this bleeding may be the first symptom of some serious renal disease and should be instructed to watch for further developments, and even to report occasionally for examination.

In view of the frequency of idiopathic renal hemorrhage such a course may seem extreme, and in certain cases it may be best to withhold from the patient any knowledge of the real possibilities of the case in order to spare his own nerves as well as those of the surgeon. But the surgeon at least should recognize that the more spontaneous the bleeding and the more entirely free the patient from any other symptom, the greater is the probability of malignant disease. It is for this reason that I am not inclined to discourage exploratory nephrotomy for the purpose of clearing up the diagnosis. This operation has no mortality and few discomforts; and although the hemorrhage may often be checked without it, the assurance that there is no beginning cancer in the kidney is worth having at this cost.

The side from which the bleeding comes is readily determined by the ureter catheter. Renal functional diagnosis between idiopathic and neoplastic hematuria is not always possible.

Treatment.—Idiopathic renal hemorrhage may usually be checked by the administration of 0.5 gram of turpentine in capsules three times a day. By this treatment, sometimes adding a fluid diet and diuresis by mineral waters, I have been able to cure some five or six cases. In one striking case the patient had been bleeding profusely for a month. Every drop of urine passed was stained dark red by the contained blood. One week on turpentine sufficed to check the bleeding absolutely and permanently. Yet in another case the bleeding was checked by turpentine, recurred several years later, and was then not amenable to that drug, nor would the patient accept the suggestion of operative exploration.

Cantharides in small doses has been serviceable in the hands of some, and the fluid extract of senecio aureus has its supporters, though it has not proved as useful in my hands as turpentine.

Hagner [1] has checked several cases (notably one of constant bleeding for thirty-six years) by passing the ureter catheter. Young and others have achieved a like result by injection of adrenalin into the renal pelvis.

In case all such methods fail, pyelotomy should be performed and the bleeding papilla curetted. If this fails, nephrectomy is required.

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[1] *Trans. Am. Urolog. Ass'n*, 1907, i.

VARICOSE VEINS OF THE BLADDER

A few cases have been reported which showed only one symptom—i. e., a spontaneous, profuse, uncontrollable hemorrhage of the bladder, which hemorrhage was found to arise from a ruptured varicose vein lying immediately under the mucous membrane. The diagnosis was made either by cystoscopy as the hemorrhage was ceasing, or by suprapubic cystotomy undertaken for the relief of the hemorrhage, as in Dr. Ellsworth Elliot's case. If the hemorrhage does not stop spontaneously the only treatment is cystotomy with ligature or cauterization of the bleeding point (Pl. I).

CHAPTER L

CYSTS AND TUMORS OF THE KIDNEY

CYSTS

Five varieties of cysts occur in and about the kidney. These are:

1. Multiple small cysts.
2. Large simple cysts.
3. Cystic degeneration.
4. Echinococcus cysts.
5. Paranephritic cysts.

1. **Multiple Small Cysts.**—Multiple small cysts are those dilatations of the renal tubules that are often seen in kidneys affected with chronic nephritis. They usually occur in the cortex and often project beneath the capsule. They may be single or multiple; they do not seem to attain a large size and are of purely pathological interest.

Paranephritic cysts also may be dismissed with a word. They are extremely rare; they may arise from the suprarenal capsule; they may be hydatid or the result of an encysted perinephritic hematoma. They are not distinguishable from other cysts of the kidney except by exploratory incision. Morris has collected their published records.

2. **Simple Cysts of the Kidney.**—It is not necessary to delay over the debated pathogenesis of this condition. Suffice it to say that single, large serous cysts are occasionally found projecting from the surface of the kidney. Such cysts may be single or multiple. They may be associated with chronic interstitial nephritis; they are rarely bilateral. The contents of the cyst are serous or hemorrhagic, never urinous. Such cysts give rise to no symptoms unless they attain such a size as to produce a tumor or to cause pressure pain. Under these circumstances the tumor is habitually mistaken for hydronephrosis, renal echinococcus, ovarian cyst, or some other tumor. Exploratory incision reveals the nature of the disease. The proper treatment of such cysts is to excise them with the adjacent portions of the renal tissue, or, if this is impracticable, to cut away as much of the cyst as possible, to sear the surface of the remainder with carbolic acid, and to close the lumbar wound, leaving a drainage-tube to the kidney. When the cysts are multiple

Morris advises that the smaller ones be neglected. Engländer [1] has reviewed the reported cases from the surgical point of view.

3. **Cystic Degeneration of the Kidney** (*Large Polycystic Kidney*).—The kidney is said to undergo cystic degeneration when it is

Fig. 104.—Polycystic Kidney (Morris).

converted into a congeries of cysts which leave scarcely any of its parenchyma in a normal condition (Fig. 104). The pathogenesis of this condition is hotly debated. The three favorite theories are:

1. That the cysts are incidental to a chronic interstitial nephritis. This explains the bilateral nature of the disease, but does not show why it should be associated with a similar cystic condition in other organs, notably the liver.

2. That they are outgrowths from fetal remains.

3. That they are cystadenomata. These two latter theories explain neither the implication of other organs nor the bilateral nature of the disease.

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[1] *Archiv f. klin. Chir.*, 1901, lxv, 112.

So much for the unsatisfactory theories. From the clinician's point of view the facts, though definite enough, are equally unsatisfactory. The disease occurs at all ages. In the fetus the kidneys have been known to be so much enlarged as to obstruct labor. Certain writers have endeavored to distinguish congenital cystic degeneration from that which occurs in adults, but there is no very obvious reason for this distinction. In either case both kidneys are habitually implicated. Dickinson found only 1 case in 26 with unilateral disease, while of 62 cases collected by Lejars only 1 was unilateral, and even in that one there was a single small cyst in the opposite kidney (Morris). Another peculiarity of the disease is the frequency with which the liver is involved. Of Ritchie's 88 cases 86 were bilateral, the liver was cystic in 21, and the thyroid gland, the uterus, and the ovary each cystic in 1 case. According to Still, the cystic liver is rarely found associated with congenital cystic kidney.

Pathology.—The most striking feature of the fully developed cystic kidney is its size. The organ grows so large as to fill the entire lumbar region and to project anteriorly almost to the median line. The disease usually progresses more rapidly upon one side than upon the other, so that one kidney may be so much enlarged as to form a visible abdominal tumor, while the other can be distinguished only by palpation. The largest recorded specimen weighed 16 pounds (Hare).

Apart from its size, the most striking characteristic of this growth is its pathognomonic irregularity of surface. When the kidney has grown to such a size as to cause a surface tumor it may be methodically palpated, and such palpation will reveal the existence over the growth of larger or smaller rounded lumps, some hard, some elastic, and some even fluctuating. This characteristic irregularity of surface is absolutely pathognomonic of cystic disease of the kidney.

On section the cystic kidney shows an infinite number of cysts of varying sizes. With the naked eye it may be impossible to detect any normal renal tissue. The contents of the cysts are liquid, viscid, colloid, or caseous. They are usually amber-colored, rarely dark and hemorrhagic, and exceptionally suppurating. The cyst contents are not urinous, and the cysts do not communicate with the sinus of the kidney. Exceptionally calculi are found in the cysts, and there are cases in which calculous obstruction of the ureter seems to have had something to do with the cystic dilatation of the kidney.

Symptoms.—The symptoms of the disease are habitually those of chronic interstitial nephritis, and, unless the tumor grows to such a size as to attract the surgeon's attention, the disease runs its course and terminates as chronic nephritis. The urine is albuminous and contains casts. There is slight albuminuria and habitually some polyuria.

The surgical symptoms are hematuria, which occurs in 25 per cent

of all cases (Newman [1]), tumor, and pain. Pyuria from secondary infection is occasionally associated with secondary calculus.

The course of the disease is slow. Morris estimates the expectation of life at from one to ten years, although Ritchie has recorded a case living twenty-two years after the diagnosis had been made.

Diagnosis.—So rarely does the renal condition attract attention that only 5 of Lejar's 62 cases were correctly diagnosed during life. Accord-

FIG. 105.—OUTLINE OF POLYCYSTIC KIDNEY AND SPLEEN. Duration 8 years; death six months later. Right kidney and liver also involved.

ing to Morris, the tumor is discovered during life in 25 per cent of cases, and about 50 per cent complain of symptoms closely resembling those of chronic interstitial nephritis. When there is hemorrhage or pyuria a slight enlargement of the kidney is likely to be mistaken for any one of the surgical diseases of that organ, and the diagnosis can only be made by surgical exploration.

Treatment.—*Cystic degeneration of the kidney is not a surgical disease;* in its clinical aspects it is a chronic interstitial nephritis. Even though the kidney causes pain or grows so large as to be inconvenient, little help may be expected from the knife. Nephrotomy is useless unless there is a stone to be removed from the renal pelvis. Puncture or incision of the cysts has no controlling effect upon them. Nephrectomy has been practiced by various surgeons with disastrous results. Morris has been encouraged by his singular good fortune to advise nephrectomy when the opposite kidney has been shown to be normal by palpation through an abdominal incision. But, of his 5 cases, 1 died after a

[1] *Glasgow Med. Jour.*, 1897, i, 324, and ii, 42.

double nephrotomy, 1 after a nephrectomy, and 2 others who submitted to nephrectomy are alive and well after two and six years respectively. Morris performs nephrectomy for the removal of a rapidly increasing unilateral tumor or for the relief of gastro-intestinal symptoms.

4. **Echinococcus Cysts.**—Echinococcus cysts of the kidney are rare. Houzel[1] collected the statistics of Finsen (Iceland), Thomas (Australia), Neisser, and Davaine, a total of 2,111 cases of echinococcus cysts in men, with only 115 (5 per cent) instances of renal echinococcus.

The cyst arises in the cortex of the kidney and grows slowly, without producing symptoms, until it reaches such a size as to form an obvious tumor, or ruptures. When left to itself the cyst habitually bursts into the pelvis of the kidney, and its contents are discharged through the urethra. This occurs in 52 of the 63 cases collected by Roberts.[2] In 3 of these cases the cyst ruptured into the intestines as well, once into the stomach, once into the lungs; and of the 11 remaining cases 8 did not rupture, 2 were incised, and 1 burst into the lungs only. In only 18 of these cases was the tumor distinguished during life. Suppuration of the cyst may occur after it has ruptured. The results of rupture are not necessarily good. The cyst may for years continue to discharge without ever emptying itself.

The symptoms of the disease are lumbar tumor, growing slowly, with little fever or pain, and no constitutional symptoms. The tumor itself simulates a hydronephrosis, and the hydatid fremitus can rarely be obtained. Later in the disease rupture of the cyst is betokened by a renal colic and followed by the discharge of hydatid vesicles through the urethra.

Treatment.—Twenty of Roberts's cases recovered and 19 are known to have died. The only treatment of the disease, and often the only means of making a diagnosis, is nephrotomy. After the cyst has been incised and thoroughly washed out a cure may be expected. It is scarcely necessary to excise the entire cyst, and in a number of cases nephrectomy has proved fatal.

SOLID TUMORS OF THE KIDNEY

Recognizing the obscurity that still shrouds the origin and the nature of so many renal growths, I shall not endeavor to follow any pathological theory nor even to discuss the opposing theses advanced by different authors. There are a sufficient number of known clinical facts to afford us a very fair basis for therapeutic conclusions without encroaching upon the purely scientific aspects of the case, which are, as Kelynack[3]

[1] *Revue de chir.*, 1898, xviii, 689, 811.

[2] "Urinary and Renal Diseases," 2d Edit., Phila., 1872, p. 566.

[3] "Renal Growths," Edinb. and Lond., 1898.

remarks in the opening chapter of his detailed investigations, "by general admission very obscure."

BENIGN TUMORS

Benign tumors of the kidney are extremely rare. The commonest of them is the renal lipoma, the benign type of hypernephroma. Yet, since this tumor so commonly becomes malignant, it is safest always to consider and treat it as such.

Some doubt is thrown upon the existence of true fibroma. Myxoma, chondroma, osteoma, angioma, lymphangioma, and lymphadenoma have all been described in single cases. These benign growths have no clinical features. They do not give rise to any symptoms and the diagnosis is only made postmortem. Their sole interest lies in the fact that most of them are liable to malignant degeneration.

MALIGNANT GROWTHS

Frequency.—Nine cases of primary renal tumor were recorded in 4,505 autopsies. Secondary deposits were found in the kidneys 10 times in 126 cases of carcinoma, and 10 times in 69 cases of sarcoma. While these secondary deposits are commonly bilateral the primary malignant disease is habitually unilateral (Kelynack). Renal growths are about equally frequent in the two sexes and on the two sides. The distribution of the disease throughout life is rather striking. Kelynack has tabulated 160 cases as follows:

Up to the age of one year	12 cases.
From one to two years	23 cases.
From two to three years	16 cases.
From three to four years	17 cases.
From four to five years	6 cases.
From five to nine years	10 cases.
From nine to eighteen years	no cases.
From eighteen to twenty-five years	7 cases.
From twenty-five to thirty-five years	8 cases.
From thirty-five to forty-five years	17 cases.
From forty-five to fifty-five years	22 cases.
From fifty-five to seventy years	22 cases.

In other words, more than half the cases occurred in the first decade of life; only 15 occurred between the ages of nine and thirty-five; while of the remaining 61, 34 occurred between the ages of forty-five and sixty. Thus the malignant tumors of the kidney may be considered clinically as the tumors of childhood and those of adult life. In childhood they are most common from birth to the fifth year, exceptional after the tenth year. In adults they occur most commonly between the

forty-fifth and the sixtieth year. Sixty-one of the 68 cases seen by Israel occurred between the fiftieth and the seventieth year. The majority of the tumors of childhood are sarcomata, while those of later years are hypernephromata and carcinomata. Of 138 cases of sarcoma collected by Walker, 116 occurred before the fifth year. Trauma and heredity have not been shown to influence tumors of the kidney, while nephritis, suppuration, and stone are accidental and secondary rather than primary.

Watson gives the following table:

Hypernephroma (12 benign)	45 cases.
Hypernephroma of the adrenal (1 benign)	4 cases.
Papillary adenoma	11 cases.
Papillary cyst-adenoma	4 cases.
Sarcoma	2 cases.
Perirenal sarcoma	1 case.
Carcinoma	3 cases.
Fibroma	14 cases.
Lipoma	5 cases.
Myxoma	1 case.
Papilloma of the pelvis	1 case.
	91 cases.

Hypernephroma.—Hypernephroma, the *struma lipomatodes aberratæ renis* of Grawitz, is a renal growth starting from an inclusion of adrenal tissue. Aberrant fragments of adrenal tissue from which this tumor may grow are rarely found in other portions of the body, commonly in the kidney. The growth assumes a benign and a malignant form.

The benign form resembles and was, until the investigations of Grawitz, supposed to be an encapsulated lipoma; but stained sections of the growth show it to have the microscopic structure of adrenal tissue. The benign hypernephroma has, however, a marked tendency to become malignant, to burst through its capsule and invade the parenchyma of the kidney itself. Yet, even in the malignant type of the disease, the capsule is usually sharply outlined.

On microscopic examination the growth exhibits a structure which markedly recalls the cortex of the normal adrenal. There is a network of capillaries which constitutes the stroma of the tumor, and upon these **capillaries,** arranged sometimes in palisade form, situated close to their walls without intervening tissue, the cells of the growth are arranged. It is the stroma formed of capillaries surrounded by epithelium which is the most characteristic feature, and it is this feature which has given rise to the opinion that the growth must be an endothelioma or an angiosarcoma. The cells are polygonal in outline, slightly larger than the normal adrenal cell, and they may contain infiltrated fat, which, when dissolved out,

gives to the cell a vacuolated appearance. Glycogen and lecithin have been found in these growths. The cells are sometimes arranged in alveoli, which are surrounded by capillaries, upon which the cells rest. This is especially a feature of the malignant form, and this alveolar arrangement has given rise to the opinion that the growth must be a carcinoma or an alveolar sarcoma. The richest blood supply is always near the periphery and areas of necrosis are not infrequent in the middle of the growth. The central portion of the adrenal is sometimes, though rarely, seen typified in these growths. (Watson.)

It is obvious from the above remarks that the classification of the hypernephromata is still doubtful.

Carcinoma.—Most of the tumors classified by the older authors as carcinomata are, in fact, malignant hypernephromata. True carcinoma is rare. It is usually of the adenomatous type.

Sarcoma.—Spindle-celled, round-celled, and fibro-sarcomata are described. They are extremely rare in the adult, while the sarcomata which compose almost all the renal neoplasms of childhood are almost exclusively embryonic tumors.

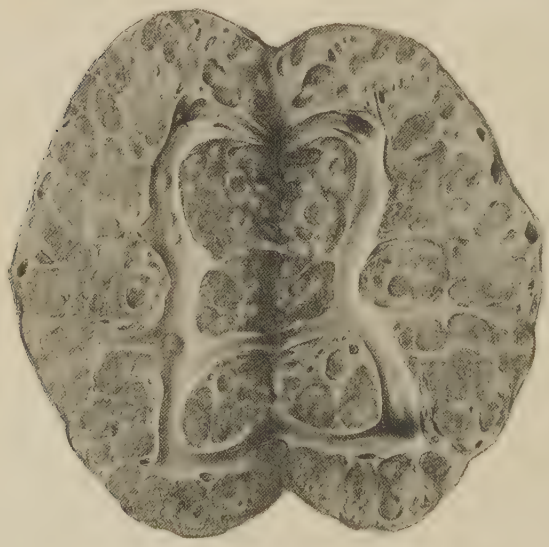

FIG. 106.—MALIGNANT ADENOMA OF THE KIDNEY.

Adenoma.—Benign and malignant adenomata are described.

Embryonic Adenosarcoma.—This is the renal neoplasm of childhood *par excellence*. It consists largely of adenomatous tissue, mingled with which are found areas of sarcoma, rhabdomyoma, leiomyoma, enchondroma, and osteoma. These tumors were first properly classified by Wilms.[1]

SYMPTOMS OF MALIGNANT GROWTHS

The symptoms of renal tumor are:

Hematuria.	Urinary symptoms.
Tumor.	Compression symptoms.
Pain.	General symptoms.

[1] "Mischgeschwuelste der Niere," Leipzig, 1899.

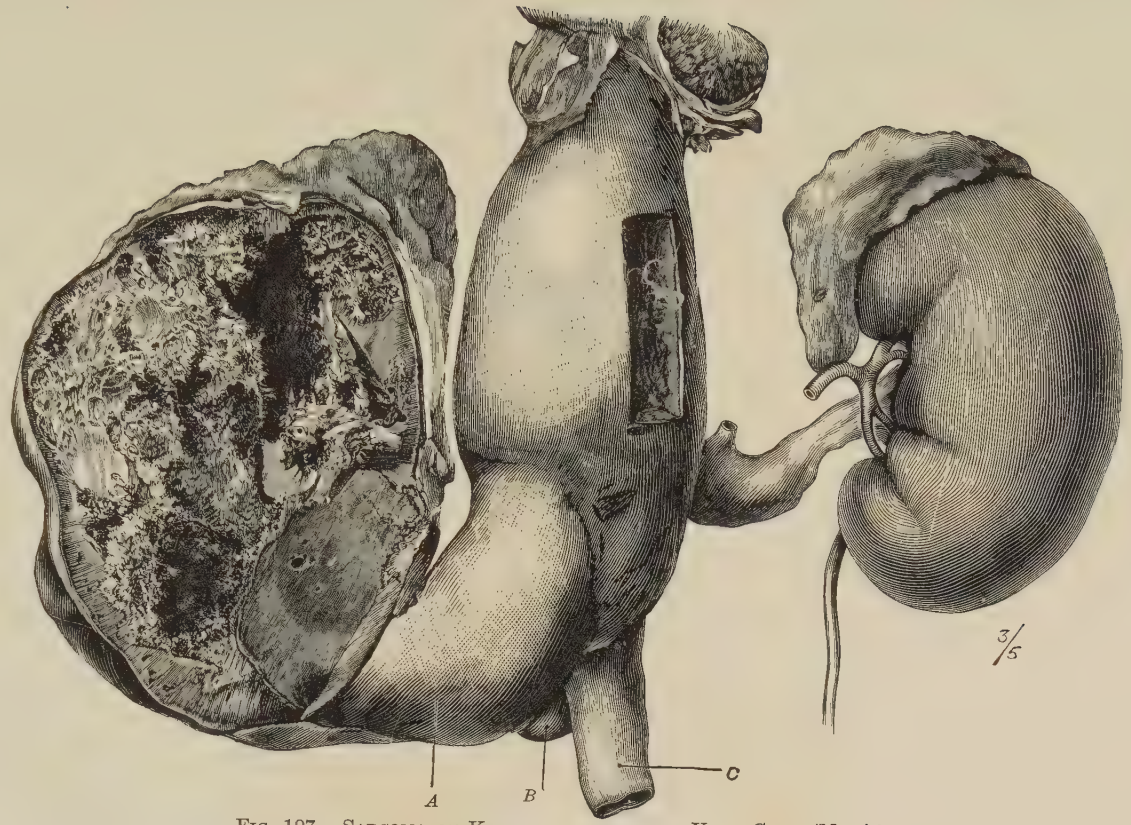

FIG. 107.—SARCOMA OF KIDNEY INVADING THE VENA CAVA (Morris).
A, sarcomatous renal vein; *B*, sarcomatous gland; *C*, vena cava.

Hematuria.—Hematuria is usually the first symptom of renal tumor in the adult. This was the first symptom in 138 out of 257 cases studied by Albarran.[1] Hematuria occurred during the course of the disease in 235 out of 357 cases.

The hematuria is characteristically abundant, painless, spontaneous, and not influenced by motion or rest. The only pain excited by hematuria is due to the passage of clots through the ureter. These clots may sometimes be discerned in the urine by their wormlike shape. Albarran states that any clot more than 10 cm. long is derived either from the urethra or the ureter.

The hematuria may occur many years before any other symptom. Thus Hildebrand has reported cases in which the intervals between the appearance of blood and any other symptom of tumor were eight to twelve years. The hematuria may be so profuse as to cause grave anemia.

In children hematuria is much rarer than in adults. Albarran found it only 22 times in 140 cases.

Renal Tumor.—Renal tumor, accompanied by little or no pain, is usually the only symptom of renal neoplasm in children until the cancerous cachexia begins to show itself.

In adults, a tumor is usually discernible at the time of operation, though, if the diagnosis can be made before any considerable increase in the size of the kidney has taken place, the prognosis is thereby amazingly bettered. Albarran's statistics show only 53 cases out of 257 in which tumor was the first symptom.

Pain.—Pain was one of the first symptoms of renal tumor in the adult in 91 of Albarran's 257 cases, and occurred during the course of the disease 134 times in 303 cases. Pain is usually, but not always, felt exclusively in the loin.

Urinary Changes.—The urinary changes consist usually in a lower excretion of urea, a relatively flat curve by experimental polyuria, the presence of albuminuria, and sometimes of microscopic hematuria or of blood casts. Pus is rare. Rovsing attaches some importance to the presence of carbonate of lime in the urine, which he says is frequent in cancer, rare in stone.

Compression Symptoms.—The nerves, the ureter, and even the intestine may give compression symptoms from the presence of a large renal growth. The important symptom, however, in this connection is *varicocele*. Strikingly large varicocele is sometimes one of the symptoms of renal tumor—evidence of compression of the spermatic vein. It is more common on the left side than on the right, and Legneu believes that the presence of varicocele is evidence that the renal vein is

[1] "Les Tumeurs du Rein," Paris, 1903.

compressed by enlarged lymph glands. According to this thesis, varicocele would be almost a contra-indication to operation; but Albarran and others have shown that there may be marked glandular enlargement without varicocele, marked varicocele without glandular enlargement.

Clinical Types

Albarran recognizes the four following clinical types:

(1) The regular type, characterized by hematuria and tumor.

(2) The hematuric type without tumor.

(3) The tumor type without hematuria (the common type among children).

(4) The painful type.

Diagnosis of Malignant Renal Growths

The diagnosis presents itself under two phases:

(1) When tumor is absent.

(2) When tumor is present.

Diagnosis in the Absence of Tumor.—If no tumor can be felt in either kidney region, the symptom that leads to the suspicion of renal tumor is invariably hematuria—hematuria with the characteristics of tumor, painless, spontaneous, profuse, and total (i. e., not terminal hematuria).

Cystoscopy and ureter catheterism determine whether this hematuria occurs in the bladder or descends from the ureter of one or the other kidney, and the question then arises, Is the hematuria of the so-called essential type, or is it due to neoplasm? It is practically almost impossible to make the distinction without operative exploration. "Cancer cells," i. e., epithelia of unusual shape or size, are rarely found in the urine in sufficient number to be suggestive. Functional tests may be of service.

Unfortunately, however, renal tumors so small as not to be palpable are usually surrounded by a considerable amount of normal renal tissue; hence the impairment of function on the afflicted side, even in the case of tumor, may be slight. This difficulty of diagnosis constitutes one of the greatest dangers in the diagnosis of renal hematuria. It would seem safer, in every case, to submit the kidney to operative investigation, in order to be sure that it does not contain a small tumor, for at this stage malignant renal neoplasms are eminently curable, while later, after they have grown sufficiently to produce a palpable tumor, the kidney is usually excised in vain.

Diagnosis in the Presence of Tumor.—When the renal neoplasm has attained sufficient size to be palpable, the fact that it is in the kidney and not in one of the surrounding organs may usually be determined by the functional renal tests, although in young children these are usually not applicable, and one must depend upon the physical characteristics of the tumor in the loin. The presence of a large tumor in the loin of the child almost invariably means malignant growth in the kidney.

Treatment

The only treatment is nephrectomy, and should always be attempted unless the cachectic condition of the patient or functional deficiency of the opposite kidney forbid.

In operating, an attempt should be made, as soon as the loin is opened, to palpate the great vessels and the renal pedicle. If enlarged glands are found in this region, nephrectomy will almost certainly fail to remove all the growth, may result in tearing of the vena cava, and should, generally speaking, not be attempted.

If nephrectomy is undertaken, every effort should be made to remove the fatty capsule in one mass with the kidney, and in practicing this removal one should be on the lookout for sharp hemorrhage from the greatly dilated veins that often run in this fatty capsule, entirely apart from the true pedicle of the kidney.

CHAPTER LI

TUMORS OF THE BLADDER

VARIETIES

The great majority of tumors of the bladder are of epithelial origin. These tumors begin habitually as seemingly papillomatous growths, which soon undergo malignant degeneration. Next in frequency come the connective-tissue growths, fibroma, myxoma, and sarcoma, and the mixed tumors, fibromyxoma and myxosarcoma. Isolated examples of other neoplasms have been recorded, such as leiomyoma,[1] rhabdomyoma,[2] angioma,[3] chondroma,[3] nevus,[4] epithelioma, and adenoma.[5] Epithelial, dermoid, and hydatid cysts have also been observed.

Here, also, we may add a study of leukoplakia vesicæ [6] and cystitis cystica, though these are not true neoplasms.

ETIOLOGY

No more is known about the pathogenesis of tumors of the bladder than about that of any other tumors. It has been surmised that a papillary tumor might originate from the hypertrophied formations met with in chronic cystitis, and the rare epithelioma is said to arise from the cornified epithelium (leukoplasia) produced by the same disease. In confirmation of this theory are the reports of Lichtenstein [7] and Wendel [8] concerning epithelial bladder tumors resulting from cystitis due to anilin dyes. But, generally speaking, tumors of the bladder are clinically the cause, not the result, of inflammation.

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[1] Terrier and Hartmann, *Revue de chir.*, 1895, xv, 181. Ramsay, *Phila. Med. Jour.*, 1900, vi, 43, 86.

[2] Livio, *Rivista clinica*, 1887, xxvi, 42. Pavone, *Guyon's Annales*, 1899, xvii, 68.

[3] Albarran, "Tumeurs de la vessie," Paris, 1891. Langhans, *Virchow's Archiv*, 1879, lxxv, 291.

[4] Arbuthnot Lane, *Brit. Med. Jour.*, 1895, i, 1093.

[5] Rafin, *Assoc. Franç. d'Urol.*, 1905, ix.

[6] Hallé, *Guyon's Annales*, 1906, xiv, 481.

[7] *Deutsche med. Wochenschr.*, 1898, xxiv, 709.

[8] *Jour. Amer. Med. Ass'n*, 1900, xxxiv, 1256.

Frequency.—Though much more common than neoplasms elsewhere in the urinary tract, bladder tumors are, nevertheless, rare. In the Urinary Service at Necker 55 tumors were found among 1,150 male patients (1888–91).

The relative frequency of bladder tumors is suggested by the following table, compiled by Watson:

Carcinoma	100 cases.
Papilloma	21 cases.
Myxoma	3 cases.
Myoma	3 cases.
Fibroma	2 cases.
Sarcoma	2 cases.
Angioma	1 case.

Age and Sex.—Men suffer from tumors of the bladder at least twice, perhaps thrice, as often as women. Of 99 cases of bladder cancer collected by Nason,[1] 78 occurred in men. Tumors have been met with at all ages, but the great preponderance of carcinoma makes the decades between thirty and sixty the most prolific of neoplasms.

Myxoma and sarcoma occur in childhood.

Multiplicity.—From 25 per cent (Albarran) to 40 per cent (Fenwick [2]) of tumors of the bladder are multiple. This multiplicity is due chiefly to the contact inoculation of the epithelial tumors. The growth seems to give rise to secondary deposits in that part of the vesical mucous membrane that comes in contact with it when the bladder is empty.

Situation.—The commonest point of origin for tumors of the bladder is the immediate neighborhood of the ureteral orifices. They are fairly frequent about the neck of the bladder, but show no special affinity for the remainder of the trigone. A point of great importance in the cystoscopic diagnosis of neoplasms is the fact that the primary tumor is almost always found in the lower half of the bladder. The upper half is involved frequently enough, but usually by extension or contact inoculation from the original growth.

PATHOLOGY

Epithelial Tumors.—We may overlook the rare epithelioma and adenoma—the latter always a prostatic growth—to concentrate our attention upon the commonest of all bladder tumors, the papilloma and the carcinoma.

Papilloma (*Villous Tumor, Papillary Fibroma, Fimbriated Papilloma*).—This neoplasm has been gracefully described by Thompson [3] as follows:

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[1] *Brit. Med. Jour.*, 1901, i, 1199.

[2] *Lancet*, 1888, i, 473.

[3] "Tumors of the Bladder," London, 1884, p. 57.

The most obvious characteristic of the growth is a structure in which the vesical mucous membrane is developed into fine papillæ, which consist of long fimbriated processes of extreme tenuity, and usually form a group arising from a small circumscribed base (Fig. 110). This last-named part contains other and more solid structure than that which enters into the papillæ themselves. Sometimes the processes are almost single, thread-like forms arranged side by side, and undivided for a considerable distance; others are bifid, generally more compound still; some may be described as digitate, and occasionally the processes radiate and suggest forms resembling those of leaves. Immersed in fluid, the long fimbriated growths float out like slender-leaved aquatic plants in deep water, and when removed to air collapse and form a soft mass resembling a small strawberry.

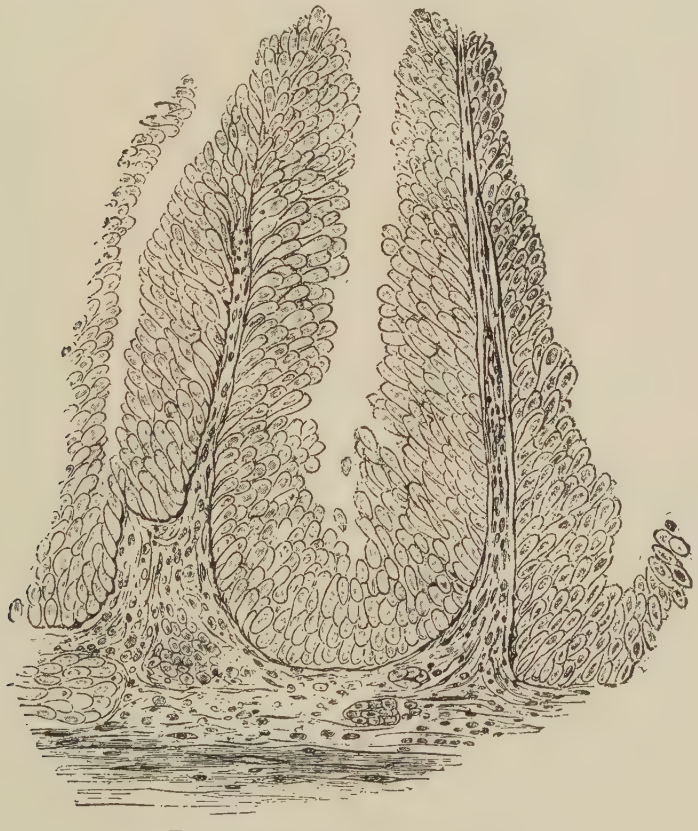

Fig. 108.—Papilloma of Bladder.

The villi are composed of capillary loops covered by several layers of columnar epithelium (Fig. 108). The "more solid structure" of the pedicle contains the muscular, fibrous, and vascular elements of the bladder wall. Exceptionally, independent villi spring from the wall of

the bladder itself, or the pedicle is short and broad, giving the growth a sessile appearance (Pl. I).

The *diagnosis* of papilloma can, however, be made neither by cystoscopy nor by the sense of touch during operation. Only a *microscopic examination of its base* can determine it to be truly and wholly papillomatous, for one commonly sees tumors that look and feel like papilloma, and that have purely papillomatous bodies, but characteristically carcinomatous bases.

Indeed, *papilloma of the bladder is often a malignant growth*, even when the microscope reveals no malignancy about it. The evidence of this is the following:

1. The papilloma, if not removed early, often becomes multiple by contact inoculation, and ultimately becomes a manifest carcinoma.

2. If excised, recurrences are frequent, and often occur in the suprapubic scar, as though by contact inoculation at the time of operation. Moreover, a papilloma, so diagnosed by sections of the base, may recur as a carcinoma.

3. The following table (Watson) expresses the frequency of recurrence in 141 cases with known postoperative histories:

Recurrences	42	(29.8%)[1]
Nonrecurrences	28	(20.0%)
Not followed	71	(50.2%)

Other observers have noted an even higher percentage of recurrences. Rofin [2] estimates it at 57 per cent.

This carcinomatous recurrence of papillomata is currently spoken of as a secondary malignant change in a benign growth. But since pathologists do not grant that this secondary malignant degeneration has been proven, it is safer to consider every papilloma, even after examination of its base has failed to demonstrate any trace of malignancy, as a carcinoma (Bosch [3]).

Carcinoma.—Lobular, alveolar, reticular carcinoma, myocarcinoma, adenocarcinoma, and cylindroma have been described. Without entering into the minute pathology of these varieties we may be satisfied to divide carcinomata into three clinical types: 1. Primary carcinoma. 2. Degenerated papilloma. 3. Secondary carcinoma (Pl. I). Of the last variety nothing need be said. Of the other two the former occurs as an infiltration of the vesical wall. It is a sessile tumor projecting more or less into the bladder (Fig. 109). Its surface is fungating, often necrotic, ulcerated, and covered with adherent lime salts. Its base extends deep into the muscle of the organ. On the other hand, the degen-

[1] Of which 13 (9.2 per cent) occurred after three years.

[2] *French Urol. Ass'n*, vol. ix. [3] *Am. Soc. Belge d'Urol*, 1909, ix, 73.

erated papilloma (papillary carcinoma) has no very fixed character. It may appear to be a pure papilloma until the microscope reveals areas of carcinomatous degeneration in the pedicle (Figs. 110, 111). In a more advanced stage the tumor retains the superficial aspects of a papilloma, but the base, broad, hard, and infiltrating, is clearly cancerous.

Fig. 109.—Alveolar Carcinoma of the Bladder.

Propagation. — Papilloma is apparently propagated only by contact inoculation. Carcinoma is propagated in three ways: (*a*) by contact inoculation, (*b*) by infiltration of the surrounding tissues, and (*c*) by lymphatic involvement.

Contact inoculation occurs in two ways. Either the growth appears at various points in the mucosa that fall against each other when the viscus is empty, or relapse after operation occurs in the suprapubic scar, and is apparently due to inoculation at the time of operation.

Fig. 110.—Villous Carcinoma. (Albarran.)

Fig. 111.—Lobulated Carcinoma. (Albarran.)

Lymphatic involvement carries the carcinoma to the iliac glands and thence to the lumbar glands.

A broad distinction may be laid down between the rapidity of dis-

semination in vesical and in prostatic growths. The former (except sarcoma) progress slowly, remain for years confined to the bladder, and but rarely give rise to metastatic growths of any clinical importance. Pasteau [1] has shown that the glands along the iliac vessels are enlarged in 43 per cent of all sessile tumors of the bladder and in 85 per cent of infiltrated tumors; but the infection gets little farther than this: the patient dies of secondary functional and inflammatory disturbances of the urinary organs. Prostatic growths, on the contrary, are disseminated throughout the pelvis with frightful rapidity, giving rise to the *carcinose prostato-pelvienne* of Guyon (p. 560). The reason for this relatively slow dissemination of vesical tumors is not clear. It was originally attributed to the absence of lymphatics from the bladder, later to their fewness, and recently to the presence of the perivesical fibro-lipomatous inflammation which commonly occurs as a barrier to the extension of a neoplasm, as is the case in interstitial cystitis. Though these theories are not by any means fully explanatory, the fact that bladder neoplasms grow slowly remains true.

Secondary Lesions.—Any tumor of the bladder may undergo fatty, granular, colloidal (malignant), or calcareous degeneration. It may also become inflamed, ulcerated, or incrusted with salts of lime. Perforation of the bowel and of the peritoneum are exceptional.

The secondary changes in the urinary organs are of greater importance. The tumor acts in very much the same way as a hypertrophied prostate. It offers a point of least resistance for the origin of cystitis, and, sooner or later, it obstructs the orifice of the urethra and interferes with the contractions of the bladder, thus setting up the long train of secondary phenomena of retention with infection, cystitis, pyelonephritis, etc., terminating only with the patient's death.

Other Tumors.—The other tumors of the bladder are not sufficiently frequent to require more than a summary consideration.

Sarcoma.—Round-celled, spindle-celled, mixed-celled, lymphosarcoma, fibrosarcoma, myosarcoma, myxosarcoma, alveolar, giant-celled, telangiectatic, and chondrosarcoma are described. The tumor usually encroaches but little on the cavity of the bladder. It appears either as a hard sessile growth or an intramural infiltration. Its surface may be smooth, papillary, or ulcerated.[2]

Myxoma (*Polyp*).—Pure myxoma is exceedingly rare. The growth is usually a fibromyxoma or a myxosarcoma. The surface of the tumor is lobular and smooth, resembling polypus of other regions.

Fibroma.—Pure fibroma is very rare. The tumor being benign, usually small, and of firm texture, passes unnoticed during life, unless, as

[1] "État du système lymphatique dans les maladies de la vessie et de la prostate," Paris, 1898, pp. 46, 52.

[2] J. W. Thomson Walker, *Lancet*, December 31, 1904.

in Qahoubian's [1] case, it grows large enough to interfere with micturition.

Myoma.[2]—This tumor is usually benign, may be intravesical, interstitial, or subserous, and, like the fibroma, passes unnoticed unless it interferes with the mechanism of urination.

Cysts.—Several varieties of cysts occur in cystitis. They have no clinical significance. Urachus cysts receive special consideration at the end of this chapter. Albarran describes a cystadenoma.

Dermoid cysts occasionally occur in the wall of the bladder. They are diagnosed only when, after rupture, hair from them is passed in the urine. This symptom, pilimiction, is pathognomonic.

Echinococcus cysts grow in the pelvis and burst into the bladder. They very rarely develop primarily in the bladder wall.

Cystitis Cystica.—This condition consists in the formation of multiple cysts on the surface of the mucous membrane, apparently as a result of prolonged inflammation. The cysts are thin-walled, filled with a clear fluid, and often involve the ureter as well as the bladder. They vary from minute size to the size of a grape. They excite no symptoms. There is no known treatment for this condition.

Leukoplakia.—Leukoplakia, or epidemization of the bladder, results from prolonged chronic inflammation. It is extremely rare, occurs, as a rule, in isolated spots, but may involve the greater part of the bladder. In histological structure the leukoplakia closely resembles normal skin. Exceptionally it undergoes epitheliomatous degeneration. It may be removed by curettage or cauterization.

SYMPTOMS

Hemorrhage.—The first, the last, and often the only symptom of a tumor of the bladder is hemorrhage. In general, the more villous the tumor the more profuse the bleeding. Hence, with such tumors as myoma and fibroma, the surface of which is often covered with a normal mucous membrane, there may be no hemorrhage whatever.

The characteristic hemorrhage of a neoplasm, whether renal or vesical, begins without cause or warning, continues copious and painless, unaffected by rest, diet, or medication, and ceases, as it begins, without apparent rhyme or reason. Its cessation may leave the urine entirely normal and the patient lulled into a false sense of security by what he considers his happy escape from a perilous condition. A profuse hemorrhage of this character is almost pathognomonic of neoplasm. Yet bleeding from a tumor may not be characteristic. It may be mild and

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[1] *Guyon's Annales*, 1897, xv, 839.

[2] Ramsay, *Phila. Med. Jour.*, 1900, vi, 43, 86.

continuous, associated with cystitis, evoked by instrumentation, or amenable to treatment. It may not be the initial symptom. In short, it may assume any form. But to be characteristic it must be spontaneous, profuse, unalterable, and unaccompanied by any other symptom.

Usually the hemorrhage grows more severe and recurs more frequently as the disease progresses. But this is by no means always the case. There may be intervals of years between the hemorrhages; indeed, Albarran cites a few cases in which the hemorrhage stopped entirely after spontaneous detachment of the growth.

Hemorrhage from neoplasm of the bladder may be excited by the introduction of any instrument (especially a metal one) into that organ, and when thus produced it assumes its characteristics of profusion, painlessness (except for the passage of clots), resistance to treatment, and spontaneous cessation.

Pain and Dysuria.—These symptoms usually appear some days, weeks, or months after the first hemorrhage. Exceptionally, pain and dysuria precede the bleeding. This is alleged to occur most frequently in sarcoma. Pain may be evoked by the passage of clots; it may be due to cystitis, to obstruction of the urethra, or to the infiltration of the bladder muscle by the tumor itself. Sharp, lancinating pains also arise spontaneously from malignant growths.

Retention.—The passage of urine may be suddenly arrested by a large clot or by the tumor. In the former case, a few moments of spasm and straining may expel the clot; but if the tumor itself obstructs the internal orifice of the urethra, the condition resembles prostatic hypertrophy. All the familiar forms of acute and chronic retention, with or without infection, are encountered. The sudden shutting off of the stream, which is a characteristic symptom of stone, may be due to tumor. Thus Nitze had a patient whose stream would be suddenly obstructed unless he urinated while lying on his back. Tumors in the region of the ureteral orifice sometimes obstruct that duct partially or completely. On the whole, however, retention is an unimportant feature of the disease.

Cystitis.—The course of the disease is commonly divided into two stages: (1) before infection, (2) after infection. Yet there may be cystitis before the first symptom of tumor appears. At one time or another inflammation of the bladder is sure to occur. The tumor itself is a point of least resistance. The blood from it is an excellent culture medium. Instruments introduced into the bladder often bring infection with them, and thus in one way or another, at one time or another, cystitis occurs. When once the tumor has become inflamed there is little hope of overcoming the inflammation except by removing it; and if this is not done early in the disease the inflammation persists, spreads to the kidney, and is largely instrumental in the patient's final taking off.

The symptoms of cystitis due to tumor of the bladder are often most distressing. The dysuria is usually severe, and small quantities of foul urine full of pus and blood are passed with infinite pain and straining.

Course of the Disease.—Among 140 cases collected by Albarran the *first symptom* was hematuria in 109 (78 per cent), dysuria in 10 (7 per cent), cystitis in 5, pollakiuria in 5, and in the remainder, various combinations of hemorrhage (in 10), dysuria (in 7), cystitis (in 2), retention (in 2), the passage of shreds, and once the extrusion of the tumor from the female urethra.

During the first period of the disease, before infection occurs, the symptoms are mild. The dysuria is rarely severe, and, were it not for the hemorrhages that occur from time to time, the patient would give little thought to his urinary organs. These hemorrhages, though profuse, rarely cause any grave anemia. This condition continues for months or years. The patient's general health is excellent, and if he is shy he may bear his bleeding in silence and come to the surgeon only after cystitis has set in.

When cystitis occurs the symptoms promptly become more aggravated, and the patient, exhausted by the loss of blood and distressed by the constant spasm of his bladder, grows rapidly weaker. Albarran alleges that a sudden turn from the simple bleeding of papilloma to the lancinating pains and rapid cachexia of carcinoma can sometimes be made out. I confess that the progress of carcinoma has seemed to me almost as slow and mild as that of papilloma. I have several times watched patients pass years of comfort with a typical carcinoma of the base of the bladder. I should put the average duration of life with carcinoma at from three to five years. A papilloma may last many years before it degenerates—as all of them do in the long run—into carcinoma.

Of the 77 carcinomata collected by Albarran, 18 were not diagnosed until after they had existed more than three years. While the same was true of 20 out of 50 papillomata.

The Urine.—The appearance of the urine depends upon whether cystitis or hemorrhage is present at the time of examination. Between whiles it may be entirely normal, or there may be microscopical and chemical evidence of hemorrhage—viz., the presence of red blood cells and albumin. When cystitis exists there is commonly some hemorrhage as well, so that the urine contains both pus and blood.

The urine may also be searched for shreds of tumor tissue. These are especially common with papillomatous growths. They sometimes are as large as a pea, resemble blood clots in appearance, and are easily overlooked. If found, they confirm the diagnosis of tumor, but do not denote the character of the growth, since simple papillæ may sprout from almost any tumor of the bladder.

Casts and albumin from the kidney may appear in the urine, whether the tumor is in the bladder or the kidney.

DIAGNOSIS

The suggestion of tumor of the bladder usually comes from a typical hemorrhage. Such a hemorrhage may, however, be caused by a neoplasm of the kidney, or it may be a spontaneous renal hemorrhage of obscure origin. There are several fine points of distinction between a renal and a vesical hemorrhage, as given in the following table, but the best criterion is the cystoscope:

Differential Table of Hematuria

Tubercle.	Stone.	Bladder Tumor.	Kidney.
1. Slight and remittent at first.	Same.	Profuse and intermittent.	.....
2.	.....	Clots large.	Clots vermiform if any.
3. Little affected by exercise.	Brought on by exercise.	Little affected.	.....
4. May be produced by instrumentation.	Same.	Same.	Unaffected.
5. Associated with characteristic pain.	Same.	No pain at first, unless from clots.	May be colic.
6. Terminal hematuria common.	Common.	Infrequent.	Never.

The color of the blood is determined by the freshness and intensity of the hemorrhage, not by its source.

Cystoscopy.—Of all the instrumental manipulations employed in the diagnosis of tumors of the bladder, cystoscopy stands first, for it alone indicates the presence, the nature—as far as that can be determined—the location, and the number of tumors. The last point is especially important. Many small villous tumors, which may be distinctly seen floating in the urine (Pl. I), are almost undiscoverable when the bladder is opened and a digital or a visual examination made of its empty cavity. Unless, therefore, the exact location of every villous papilla is definitely determined by cystoscopy previous to operation, some one of them may be overlooked. The relapse which inevitably results from such an oversight exposes the patient to renewed danger of carcinomatous change as well as to the inconvenience of a second operation.

There are only two contra-indications to cystoscopy. Hemorrhage may be so free as to make it impossible to gain any accurate data, even with the irrigating cystoscope, or the bladder may be so irritable as to

frustrate the operation. In the former case a few days' delay, in the latter a general anesthetic, make the cystoscopy practicable.

An irrigating cystoscope is essential for good work.

In examining the bladder for tumor two things must be borne in mind: First, the tumor (if there is one) will be found, in almost every case, near the orifice of one or the other ureter or of the urethra; second, the tumors are multiple in a fair proportion of cases, and a complete cystoscopy should include a minute inspection of every portion of the bladder. Such an inspection requires the use of a direct as well as a prismatic telescope.

The characteristics of the different tumors, as seen by cystoscope or during operation, have already been described.

Recto-abdominal Palpation.—Bimanual examination, with the patient in the dorsal or the knee-chest position, often affords valuable information about the nature of the growth. A papilloma or a small hard tumor cannot be felt, but any considerable infiltration of the base of the bladder is readily distinguished. Such an infiltration is definite evidence of the malignant character of the growth, and indicates that extensive resection of the bladder will be required in its removal.

In making this examination the prostate gland should be delineated by the finger in order that a growth in the bladder wall may be clearly distinguished from one in the prostate.

The Stone-searcher. — When cystoscopy is impossible Thompson's searcher may be depended upon to give some evidence of the presence and nature of the growth. A large, hard tumor may be distinctly felt by this instrument, a villous growth will be made to bleed freely by its contact, and any considerable area of infiltration is distinguished by its rough, unyielding character.

Cystotomy.—Exploratory cystotomy should be performed above the pubes, not in the perineum, and the operation, like an exploratory abdominal section, should be performed for the purpose of removing the growth, if any is found, rather than for mere diagnosis.

Differential Diagnosis.—It is often impossible to distinguish between a benign and a malignant papilloma of the bladder. In general, infiltration of the bladder wall, solidity of structure, and a duration of more than two or three years may be looked upon as suggestive of malignancy. On the other hand, villosity, pedunculation, and a short history favor benignity.

The distinction between neoplasm, on the one hand, and stone, pericystitis, and hypertrophy of the prostate, simple or malignant, on the other, is made by the cystoscope and recto-abdominal touch, as described above.

TREATMENT

Palliative Treatment.—If there is any possibility that the tumor is a papilloma, palliative treatment is entirely inappropriate. The tumor should be dealt with surgically and at once. The patient must be encouraged to submit to immediate operation on the ground that delay may prove fatal. Yet, before undertaking operation, it may be necessary, even in these cases, to check hemorrhage or to alleviate cystitis.

The Treatment of Hemorrhage.—It is customary, when the patient is bleeding freely from a tumor of the bladder, to put him to bed and to restrict his diet. I am not sure that either measure is particularly efficacious; but I am sure that beyond this we tread on uncertain ground. The internal administration of the fluid extract of *senecio aureus,* in 2 c.c. doses three times a day, has given Dr. Chetwood very fortunate results. *Oil of turpentine,* so efficacious in kidney hemorrhage, has no certain value here, nor do I put any faith in other astringents administered by the mouth. I have employed saturated solutions of *gelatin* with the idea of increasing the coagulability of the blood with no success. Local measures are equally unreliable. *Silver nitrate* is praised by Thompson, and it certainly has a temporary hemostatic effect. *Alum,* in the form of Squibb's Surgical Powder, is the best application I know (heaping teaspoonful suspended in 500 c.c. of hot water).

Solutions of the *suprarenal extract* are somewhat irritating and produce only the most ephemeral results. A hot solution of *gelatin* seemed to do good at my hands in one case. *Antipyrin* has been praised. But, as a matter of fact, one of the features of the bleeding is its defiance of all medication. A desperate hemorrhage requires *cystotomy.*

The evacuation of clots may cause trouble. They are best evacuated by a large woven catheter; a Bigelow evacuator is even better if the growth is not at the neck of the bladder. Through this instrument very hot (115°) salt or alum solution is injected repeatedly. If a clot obstructs the eye of the instrument it is drawn out by aspiration. The bladder is thus emptied by repeated irrigations and aspirations. I do not care to use hydrogen peroxid in the bladder. It is irritating, the passage of the bubbles causes considerable spasm, and it is but little more efficient in disintegrating clots than is the hot alum solution.

The Treatment of Cystitis.—As in hypertrophy of the prostate, so in neoplasm of the bladder, the best way to treat cystitis is to prevent it. The *prophylactic measures* are the same in either case—viz., urinary antisepsis, and, if necessary, systematic catheterization. There is this difference, however, that if the neoplasm is at the neck of the bladder, the passage of the instrument may do more harm than the evacuation does good. In this event the bladder is best let alone. *The cure* of an existing cystitis is quite as arduous a task as the checking of a hemor-

rhage. Any local medication excites the bleeding, while general treatment is of as little use here as in any other form of cystitis. The only course to follow is to administer whatever general treatment seems to suit the patient best and to use as much local treatment as circumstances permit. As a matter of fact, the unendurable dysuria of cystitis forms one of the chief indications for *palliative cystostomy*. I have been forced to this expedient a number of times, and have always found it most serviceable. Simultaneous scraping and cauterization of the growth may be of material aid in ameliorating the symptoms.

If the pain recurs after cystostomy, double nephrostomy, followed by cystectomy, is the only way to relieve it. But the patient is usually too far gone for this.

Operative Treatment.—*Palliative suprapubic cystostomy* is the operation suited to all desperate and incurable cases. Even though no pretence is made at eradicating the disease the patient's life is prolonged by the very fact that he is relieved of his worst symptoms. I have recently had under my care a striking example of the value of this operation. Before operation the patient weighed 120 pounds, and was tortured day and night by incessant straining. Within nine months after operation he gained 43 pounds, although the tumor, which was only curetted, was a typical villous carcinoma. A year after the operation he died.

The radical operations employed for tumor of the bladder may be reduced to four types:

1. Intravesical excision.
2. Excision after cystotomy.
3. Resection of the bladder.
4. Extirpation of the bladder.

1. **Intravesical Excision.**—This is applicable only to small papillomata. Nitze claimed admirable results with his instrument (80 cases; no operative deaths; 7 recurrences), but seems not to have followed his cases very long. With our present armamentarium no other operator has achieved any notable success, for it is difficult, if not impossible, adequately to cauterize the base of the tumor after it has been snared or torn away by the operating cystoscope.

2. **Excision after Cystotomy.**—This and the other operations about to be described are all performed through a suprapubic incision.

Simple excision is suitable only for pedunculated papillomata. In removing the tumor the utmost care must be taken not to break off fragments that may infect the wound. The base must be well cauterized.

3. **Resection of the Bladder.**—Resection of that part of the bladder wall surrounding a tumor is essential in the removal of every sessile or infiltrating growth of the bladder (except the myomata), whether it is frankly malignant or not. A section of the whole thickness of this

muscle must be excised, including an area of apparently normal tissue 2 cm. beyond the limit of induration.

If the tumor lies on the upper or the lateral wall of the bladder the operation is comparatively simple. Peritoneum is stripped away if possible, the requisite section removed, and the gap sutured with two layers of catgut, the one buried for the muscle, the other for the mucous membrane. If the tumor is conveniently situated, the suture may be reënforced by a layer of subperitoneal Lembert stitches.

If the peritoneum is adherent to the bladder it may be more convenient, after irrigating the viscus thoroughly and packing it with iodoform gauze, to open the peritoneum boldly and excise the section of the bladder from without.

Unfortunately, the great majority of vesical tumors spring from the base of the bladder, from that portion of the organ, namely, which is least accessible, and where free removal of the growth is impeded by the presence of the ureters, the prostate, and the urethra.

Resection of this region (with uretero-vesico-neostomy, if necessary) is so difficult an operation that total cystectomy is usually preferable.

4. **Extirpation of the Bladder.**—Total extirpation of the bladder is a most formidable operation.

Watson has collected 38 cases, with 19 immediate deaths, 8 later deaths, and only 6 known survivors at the end of a year, only 2 of whom had been followed more than two years (Pawlik, fifteen years; Hogge, four years).

With double preliminary nephrostomy the operation is much simplified, and the operative mortality should thereby be much reduced. Whether this will make any difference in the ultimate results remains to be seen.

After-Treatment.—It has been repeatedly reported of late that irrigation of the bladder with 5-per-cent resorcin solution diminishes the tendency to recurrence of papilloma. Whether time will verify the assertion remains to be seen; but it seems wise to add to the usual postoperative treatment a course of vesical irrigations with this solution once a week for at least a year. It is, of course, essential that cystoscopy should be performed once or twice a year for at least three years after operation, in order to note possible recurrence.

CHAPTER LII

MALIGNANT NEOPLASMS OF THE PROSTATE—NEOPLASMS OF THE URETHRA

MALIGNANT NEOPLASMS OF THE PROSTATE

Malignant disease of the prostate is almost always primary. Extension of a vesical cancer to the prostate is extremely rare, while extension of a prostatic growth to the bladder is very common. Sarcoma occurs in youth, carcinoma in old age. Either form is rare, although such statistics as Tauchon's, which show, among 8,289 cases of cancer, only 5 cases affecting the prostate, certainly underestimate the frequency of the disease.

Sarcoma is far rarer than carcinoma.

Sarcoma.—Powers [1] has collected 31 cases, of which 14 were small round-celled or "mixed" growths. Of the 31, 15 occurred in children less than eight years of age (three of these in infants less than a year old), 8 between the ages of fifteen and twenty-five, and 6 between the ages of fifty and seventy.

The diagnosis is at times easy, at times difficult. A rapidly growing tumor of the prostate in a child or youth is probably a sarcoma. So, as well, is a rapidly growing, soft, balloon-like prostatic tumor in an adult. Pain is generally marked and is referred to the pubes, perineum, and rectum. Urinary urgency is not generally present in the early stages. As in the case which forms the subject of this paper, an enormous growth may be unaccompanied by residual urine.

Prognosis in these cases is necessarily bad. In each of the authentic cases submitted to analysis by the writer either (*a*) the disease went on to a fatal termination, or (*b*) the patient succumbed to operation or (*c*) to relapse after operation, or (*d*) the case was reported simply as an operative recovery. (Powers.)

Carcinoma.—Carcinoma occurs almost exclusively after the age of fifty.

Pathology.—The tumor is either medullary or adeno-carcinoma. Since Albarran and Hallé [2] found carcinoma 14 times in 100 specimens

[1] *Annals of Surg.*, January, 1908.

[2] *Guyon's Annales*, 1900, xviii, 113, 225.

that had been removed as simple hypertrophy, it has come to be recognized that about 10 per cent of the patients who seek relief for prostatism have either:

1. Benign hypertrophy in the midst of which, after prostatectomy, small inclusions of carcinoma are found, or

2. Carcinoma without hypertrophy.

The former, of course, give no symptoms (of carcinoma), and are usually cured by prostatectomy. The latter type is meant in the subsequent paragraphs.

Extension takes place at first toward the bladder. The neoplasm breaks through the prostatic capsule at its base and extends up along the base of the bladder and the seminal vesicles. Then occur ulceration of the bladder and urethra, and finally massive involvement of all the adjoining region (prostato-pelvic carcinosis) and extension forward into the membranous urethra. Young found glandular involvement in only 15 out of 40 cases.

Neoplasms of the prostate may run their whole course, extending to the neighboring organs, causing metastases and death without involving the entire gland, though it is more common for the gland to be entirely involved early in the disease. Bone metastases are especially common. Von Frisch mentions von Recklinghausen's 5 cases of insignificant primary prostatic cancer with extensive secondary bone involvement.

Symptoms.—Unfortunately, cancer of the prostate is rarely recognized until the disease is well advanced. Indeed, von Recklinghausen's cases show that the primary prostatic disease may be overlooked even at a time when the secondary growths have assumed alarming proportions. Two other facts tend to confuse the diagnosis. In the first place, the prostatic carcinoma occurs late in life, and at first causes slight symptoms which the patient refers to advancing age or to hypertrophy of the prostate, if he possesses the dangerous "little knowledge," and which may deceive even the surgeon. In the second place, the progress of the growth, though slow up to the time it breaks through the prostatic capsule, is nothing less than furious thereafter. Before the patient realizes he is sick the growth fairly fills the pelvis. It is this characteristic that has earned for the disease Guyon's title of *carcinose prostato-pelvienne.*

The disease commonly causes only insignificant discomfort until it breaks through the prostatic capsule. The first symptom is usually *pain.* This pain is often neuralgic in type. It may or may not be intermittent and be increased by urination and defecation, but it is usually constant. It is concentrated in the perineum or the rectum, and thence radiates to the genitals, the hypogastrium, and the loins, in which last place it may be especially severe. It also causes reflex sciatica, and bilateral sciatica is especially suggestive of cancer of the prostate.

Slight *hematuria,* either at the beginning or at the end of urination,

occurs in one quarter of the cases. In the later stages of the disease, when urethra and bladder are both the seat of malignant ulcerations, copious hematuria is common. *Obstructive and inflammatory symptoms* are quite those of hypertrophy of the prostate; and toward the end constant straining urination, with foul bloody urine, is the most distressing symptom. Edema of the extremities and genitals and cancerous cachexia are encountered in the terminal stages of the disease.

The growth commonly progresses with the greatest rapidity, and the patient usually dies within a year of the first appearance of symptoms. But exceptionally the new growth remains stationary or progresses but slowly for many months. Fenwick [1] makes a special class of these and compares them with mammary scirrhus. They may last for as long as three years.

Diagnosis.—The symptoms suggestive of cancer of the prostate are encountered only when the disease is sufficiently advanced to be distinguished by rectal examination, and upon this the diagnosis rests. In a pronounced case the cachectic condition, the dysuria, the foul, bloody urine, and the enlarged inguinal glands only require a cursory rectal examination to confirm the diagnosis. The finger, as soon as it passes the internal sphincter, abuts upon an enormous hard nodular tumor on the anterior rectal wall. Perhaps the rectum itself is ulcerated.

But in the beginning cases the diagnosis may be no easy matter. The growth, as felt from the rectum, assumes one of two forms: it is either a circumscribed nodule in one of the lateral lobes, remarkably hard, although not necessarily prominent, or it is a less hard, irregular infiltration of the whole gland, which cannot be distinguished from simple hypertrophy, except, perhaps, by the characteristic pain, until it has attained an ominous size, given rise to secondary glandular enlargements in the groin and along the iliac vessels, and begun to invade the bladder and the periprostatic tissues.

The differential diagnosis between carcinoma and hypertrophy is often impossible in the earlier stages of the disease (p. 304). Cancer of the base of the bladder may be distinguished from cancer of the prostate by delineating the normal prostate below the vesical growth, by observation of the urethral length, which is not increased unless the cancer is prostatic, and by cystoscopy, which shows an intravesical growth, but may fail to make out a prostatic one.

Treatment.—In order to remove carcinoma that has reached a sufficient size to be diagnosed outside the laboratory, the whole prostate must be excised, with its capsule and the bladder neck. This leaves the patient completely incontinent and, until it shall be proven to give better

[1] *Edinb. Med. Jour.*, 1899, vi, 16.

end results than one would expect, may be considered of doubtful expediency.

Palliative treatment is almost equally futile. In the early stages, sedatives, tonics, and the catheter (if there is retention) may relieve the symptoms somewhat. Later, opium, suprapubic cystotomy, as for cancer of the bladder, and colostomy, as soon as the rectum becomes ulcerated or obstructed, are the chief elements of palliative treatment.

NEOPLASMS OF THE URETHRA

Although any urethral neoplasm may occur in a virgin urethra, the neoplasms that occur in the male are found almost exclusively in patients who have had gonorrhea, and the papillomata are almost exclusively a feature of chronic gonorrheal urethritis.

The following varieties will be described:

Papilloma.
Angioma.
Fibroma.
Cysts.
Carcinoma.
Sarcoma.

Angioma and sarcoma are usually met with in the female urethra. The other varieties of tumor are found almost exclusively in the male.

Papilloma.—Papilloma of the urethra has quite the same characteristics as the so-called venereal wart that occurs upon the external genitals. Papillomata occur almost exclusively about the meatus, where they are fairly common; but quite a number of cases have been observed deeper down the urethra, as far as the bulb. They are usually multiple and are most common upon the floor of the urethra. They appear through the urethroscope as pointed, warty growths which bleed very readily. Their removal is accomplished by inserting the urethroscopic tube up to the mass of tumors, so that they project almost into its lumen. A thick swab of cotton upon a probe is then introduced and violently rubbed to and fro, scraping off the papillary growths. The immediate hemorrhage is profuse, but is readily checked by pressure. The remaining fragments may be removed by the urethral curette, and recurrence may be prevented by touching their bases with saturated alcoholic solution of salicylic acid twice a week until all tendency to growth has disappeared.

Angioma.—Angioma of the female urethra, commonly spoken of as vascular polyp or urethral caruncle, appears close to the external meatus, usually on the floor of the urethra. The growth is common at middle life, though Geraldès (Mark [1]) has reported a case in a child three

[1] *Trans. Am. Urolog. Assoc.*, 1908, vol. ii.

years of age. This tumor is exquisitely sensitive and causes agonizing pain on urination, which, combined with insistent infrequency of urination, may almost drive the patient insane. It may be cured by excision or by destruction with the thermo-cautery.

A few instances of similar growths have been reported in the navicular fossa of the male urethra.

Fibroma.—Fibromata are very rare and are usually mixed growths —fibromyxomata or fibromyomata. They occur singly, usually in the bulb, but may involve the prostatic urethra. They are extremely rare in the female. Through the urethroscope they appear as smooth, minute tumors with a distinct pedicle.

Certain wormlike polypi are difficult to see, since they lie within the folds. Mark suggests that they are more readily seen with air inflation. They may be removed by the curette.

Cysts.—Minute cysts of the urethral glands are sometimes seen in cases of chronic urethritis. Cyst of the prostatic utricle is a rare autopsy finding in infants.

Carcinoma.—Though the urethra may be invaded by carcinoma of the glans penis or of the prostate, primary urethral carcinoma is extremely rare. It occurs in two types, each an infiltration.

One type is reddish and warty; the other white, presenting the aspects of a warty leukoplakia of the tongue. The striking characteristic of the growth is its hardness when the attempt is made to curette it. This characteristic establishes the diagnosis. In the few reported cases the only treatment attempted has been excision.

Mark states that, of 21 microscopically confirmed cases, all recurred within one year, excepting one of Oberlaender's, which had no recurrence twenty-one months after a resection, and Carcey's, which showed no recurrence ten months after a total emasculation.

Dr. Abbey is at present treating a case for me by applications of radium, and the tumor seems to be gradually disappearing.

Sarcoma.—Sarcoma occurs usually in the female urethra. Eight cases of fibrosarcoma and one of melano-sarcoma have been reported. They grow rapidly, and none of them have been cured.

CHAPTER LIII

INJURIES TO THE KIDNEY AND URETER—ANEURYSM OF THE RENAL ARTERY

SUBPARIETAL INJURIES—RUPTURE

The subparietal injuries of the kidney are often classified as contusions and ruptures; but, inasmuch as with every rupture there is contusion, and with almost every contusion at least a partial rupture, while clinically contusion and rupture exhibit the same symptoms and demand the same treatment, they need not be distinguished.

Subparietal injury of the kidney, though more frequent than any other form of renal trauma, is rare. Among 13,455 autopsies there occurred only 31 instances of ruptured kidney (Morris and Herzog[1]). Güterbock,[2] however, encountered 36 ruptured kidneys among 925 autopsies, and 9 such cases among 9,500 patients admitted to St. George's Hospital. Among 198 cases collected by Tuffier, 136 occurred in adult men, and in only 2 were both kidneys injured. Two hundred and eighty-one of Küster's 306 cases were males. Of 272 in which the particulars are stated, 142 occurred on the right and 118 on the left side, 12 being bilateral (Morris).

The kidneys may be contused by a variety of accidents, such as kicks, buffer accidents, falls, and even simple muscular effort. The lower ribs may be broken and driven into the organ, and many of the accidents are explicable only on the theory that the kidney is burst either by the impact of the floating ribs compressing it against the spine (Morris) or by increased intrarenal tension (Küster).

Pathology

Subcapsular Hemorrhage.—Morris relates two instances of extravasation of blood under the fibrous capsule of the kidney, caused by slight muscular exertion and producing severe pain. Calculus was suspected, but nephrotomy revealed only a subcapsular hematoma, the evac-

[1] Morris, *op. cit.*

[2] "Die chirurgischen Krankheiten der Harnorgane," Leipzig u. Wien, 1898, iv, 900.

uation of which effected a cure. He believes that this form of rupture is not uncommon, and that the compression of the parenchyma, perhaps increased by repeated small hemorrhages, explains the irregular and protracted course of the symptoms in some cases, until ultimately the capsule gives way, the blood and disorganized parenchyma escape into the perirenal space, and this late hematoma demands operation which reveals a disorganized kidney. Such cases are usually classified as *subcapsular lacerations of the kidney substance.*

Laceration of the Parenchyma.—The kidney substance may be lacerated in any direction and to any extent (Fig. 112). Portions of the organ may be lopped off, or the whole kidney may be reduced to a pulp or torn away from its vessels and ureter. If the capsule and ureter remain intact the primary reaction is often slight; but usually both are torn, and as a result blood and urine are immediately poured into the perirenal space, at first distending it and forming a tumor in the loin, and later escaping from the orifice at the lower part of the perirenal fascia (or through any tear in it) to form a more or less generalized subperitoneal infiltration. This extravasation of blood and urine is more or less rapid in proportion to the extent of the rupture.

Fig. 112.—Rupture.

The blood also pours down the ureter into the bladder and is expelled therefrom (hematuria).

Associated Lesions.—Laceration of the perirenal fat may occur alone or in connection with rupture of the kidney. It is unimportant. Fortunately laceration of the peritoneum is rare. In the adult there is a distinct layer of fat between the kidney and the peritoneum, which permits complete disintegration of the former without any injury to the latter; but in children this layer of fat is not developed, and, therefore, rupture of the peritoneum permitting rapidly fatal hemorrhage is relatively frequent in them but rare in the adult. Rupture of the renal artery and vein is also rare. Rupture of the liver occurred in 10 out of Morris's 12 cases (an unduly large proportion). Rupture of the spleen is a less frequent complication, though, in either case, the free hemorrhage from the intraperitoneal organ is likely to make the renal lesion a secondary consideration. Fracture of the lower ribs and puncture of the diaphragm, the pleura, and the lung are among the less frequent associated lesions.

The Process of Repair.—Slight injuries of the renal parenchyma may heal promptly with but slight associated inflammation,[1] and perirenal hematoma of some size may disappear within a few weeks by diffusion and absorption. Yet the usual outcome of rupture of the kidney—if the patient survives the immediate results of the injury—is infection of the urohematoma, suppuration throughout the wound in the kidney, and gangrene of such portions of the organ as have been partially or completely torn away. The urinous, purulent collection burrows in various directions until the patient succumbs or the surgeon intervenes.

Other results are infarction, secondary hemorrhage, aneurysm of the renal artery, and traumatic hydronephrosis.

Symptoms

Apart from the systemic shock and the local pain and ecchymosis due to the bruising of the abdominal wall, there are four cardinal symptoms of rupture of the kidney directly referable to the organ itself. These are hematuria, variations in the quantity of urine excreted, tumor, and pain.

Hematuria.—The passage of bloody urine after a contusion of the loin is the most characteristic symptom of ruptured kidney. Yet the hematuria may occur when the kidney is not ruptured,[2] and, on the contrary, there may be no hematuria, even though the kidney is ruptured. Thus the blood cannot reach the bladder if there is (1) subcapsular rupture, (2) occlusion of the ureter by clot, or (3) avulsion of the kidney from the ureter. Yet hematuria was a feature in 80 per cent of the cases collected by Watson.[3]

The course of the bleeding is very irregular. The blood usually flows freely for several days, and then ceases, either because the hemorrhage has stopped, or because the ureter becomes obstructed by clots. Blood cells and albumin may persist in the urine for many days, and recurrence of bleeding is not uncommon. Exceptionally there is no hematuria for the first few days. The blood passed is usually sufficient in quantity to dye the urine a deep red; yet, as a rule, the actual amount of blood thus lost is not alarming.

Variations in the Quantity of Urine.—During the first day after the injury there is oliguria, perhaps anuria, from shock. Continued anuria

[1] Yarrow, *N. Y. Med. Jour.*, 1900, lxxi, 1.

[2] Morris gives a long list of exceptional causes of hematuria after contusion of the loin, such as slight contusion of the kidney, renal congestion, thrombosis of the renal vessels, stone, malaria, villous tumor of the bladder. But the only feature of clinical importance is the persistence of bleeding. Uncontrollable bleeding, from whatever cause, demands operation.

[3] *Boston Med. and Surg. Jour.*, July 9, 16, 1903.

indicates rupture of both kidneys, or else incapacity of the opposite kidney (if there be one) to act, and is therefore an indication for immediate nephrotomy. But usually a polyuria replaces the primary oliguria, and lasts two or three days or longer. There may be reflex dysuria or retention.

Tumor.—The extravasation of blood and urine about the kidney develops a tumor in the loin. This swelling may appear immediately, or its advent may be delayed several days, or no tumor may ever appear. The tumor is usually quite diffuse, filling the whole loin and perhaps extending even to the groin. The swelling is elastic, but fluctuation cannot be made out. General abdominal tension from the accumulation of flatus and from the tenderness of the bruised parietes may obscure a large perirenal hematoma.

Pain.—The pain of a ruptured kidney is an inconstant symptom. The superficial contusion produces local pain and tenderness; the passage of clots through the ureter may evoke renal colic, and the distention of the kidney, or its compression by effused blood, may produce an active pain radiating chiefly to the groin and testicle, and perhaps causing retraction of the latter.

Course of the Disease.—1. *The injury is slight.* There is some shock, a temporary oliguria, and hematuria. After a few days the urine becomes quantitatively and qualitatively normal. No notable tumor appears in the loin, and the patient is well within ten days or so.

2. *The injury is apparently slight,* but the symptoms, instead of growing less, or perhaps after an apparent remission, become more severe. The lumbar tumor grows larger, pulse and temperature run high, the digestive functions are not properly established, the abdomen remains distended and tympanitic, there is constipation, anorexia, perhaps vomiting, the tongue is dry, the patient listless and irritable. This clinical picture indicates progressive urinary toxemia and sepsis, and calls for prompt nephrotomy if the patient is to be saved. The presence of pleurisy, pneumothorax, or edema of the lung must not be overlooked.

3. *The injury is severe.* At first the patient is dazed, unconscious, or in a state of collapse. Hematuria and hematoma develop rapidly. He may fail rapidly and die of shock, of internal hemorrhage, of suppression, or, later, of septic complications. Or the hematoma may be gradually absorbed or become infected.

4. In the most serious cases *the renal rupture is only one among several visceral injuries.* Rapidly fatal intraperitoneal hemorrhage may occur from the kidney, liver, or spleen. The triple infliction of shock, hemorrhage, and peritonitis can be combated only by immediate abdominal section with slight hope of success.

5. *Septic cases.* No case, however mild, is free from the danger of

sepsis until the temperature has remained normal several days. Most large perirenal hematomas suppurate unless operated upon.

6. *Traumatic hydronephrosis.* Exceptionally the hematoma becomes encysted, forming the so-called traumatic or pseudo-hydronephrosis.

Diagnosis

While slight injuries to the kidneys may be overlooked, especially if overshadowed by more important lesions of the other viscera, a kidney rupture of any great significance always manifests itself by loin tumor, usually associated with hematuria and oliguria or anuria.

The use of instruments of precision, such as the cystoscope or ureteral catheter, in the diagnosis of these injuries must be deprecated, for any renal rupture that cannot be diagnosed by the symptoms above narrated is either mild enough to deserve expectant treatment or severe enough to require immediate exploratory section.

Treatment

The treatment of shock is of the first importance. The patient is put to bed, surrounded by hot-water bottles and stimulated according to his needs. In extreme cases intravenous saline infusion is admirably efficacious. Opium must be sparingly employed for fear of masking the symptoms. To check hemorrhage cold may be applied locally. Food should be of the lightest description, and the bowels should be moved by mild laxatives if possible, since active peristalsis is said to encourage hemorrhage. The catheter should be employed with the most minute antiseptic precautions, for the bloody vesical pool is more than usually receptive of infection, and infection is—after the primary shock and hemorrhage have passed—the only noteworthy danger to the patient.

But all the measures detailed above are palliative at best. By them the symptoms are modified, but the essential features of the case—the hemorrhage, the function of the opposite kidney, the infection of the perirenal hematoma—are, to all intents, unaffected. Only by the knife can the surgeon reach these, and thus the momentous questions in the treatment of rupture of the kidney are, Whether to operate? and when to operate?

Immediate operation is required only when the patient fails to rally well from his shock. The possibility of intraperitoneal hemorrhage or rupture of some of the other viscera will lead the surgeon to fortify the patient by a large intravenous infusion, and then to operate, in the desperate hope of averting the fatal issue.

The only other cases that may be subjected to immediate operation are those whose evidence of grave internal injury is associated with so

little shock as to encourage the hope that immediate exploration may prevent other and worse evils.

After the first shock is over expectant treatment may be continued on condition that the patient grows progressively stronger. Yet the surgeon must be ready to operate, and the patient and his friends prepared to submit, as soon as any unfavorable symptom manifests itself. The usual indication for operation at this juncture is continued hemorrhage, as evinced by the growing tumor in the loin, for "it is not the visible loss of blood by the bladder, but the easily overlooked but far more dangerous bleeding into the perinephritic tissues, or into the peritoneal cavity, that should receive the chief attention" (Keen [1]). Anuria persisting for twenty-four hours is an indication for immediate operation. Finally, beginning sepsis, suggested by an unfavorable temperature and pulse, must be cut short by operative drainage.

Although severe wounds in the kidney have been known to heal, the prospects of cases treated expectantly are not good. Thus, among 273 uncomplicated cases treated expectantly (Watson), 81 (30 per cent) died, and among 174 operated cases, 32 (18 per cent) died, while of the complicated cases treated expectantly, 31 out of 56 (90 per cent) died, and of the 59 complicated cases operated upon, 26 (44 per cent) died. I have operated upon 4 uncomplicated cases, with 1 death by ileus.

The Operation.—The surgeon employs the incision with which he is most familiar, as speed is all-important. The choice between the abdominal and the lumbar route depends upon whether any other visceral lesions are suspected. Though the abdominal route affords quicker control of the renal artery, the lumbar incision is habitually employed. Upon incision of the fascial envelope clots, blood, bloody urine, or pus exudes, and should be quickly washed away. If copious bleeding is encountered, the renal artery must be clamped or tied immediately, though, as a general rule, the hemorrhage may be controlled by suture of the kidney and packing. The earlier operators performed nephrectomy for rupture of the kidney, as they did for every other surgical affection of the kidney, but this grave operation is rarely necessary. Generous drainage will allow for the expulsion of such detached fragments of kidney tissue as the surgeon overlooks. A final irrigation and plentiful gauze drainage complete the operation. Secondary nephrectomy may be required if prolonged suppuration ensues.

WOUNDS OF THE KIDNEY

Wounds of the kidney (other than ruptures) are extremely rare. Even in military practice they are unusual. Of *incised and punctured*

[1] *Annals of Surgery*, 1896, xxiv, 138.

wounds (excluding bullet wounds) there are no instances recorded in the "Medical History of the War of the Rebellion." Küster [1] collected 43 cases. In 10 there were severe injuries to other organs, and of these 6 died (60 per cent), while among the 31 uncomplicated cases there were only 4 deaths (12.9 per cent). Keen records 8 cases with 2 deaths. Among Küster's cases 10 were operated upon (2 primary and 6 secondary nephrectomies), with no deaths; Keen records 4 nephrectomies without a death.

Morris sums up the diagnostic features of the condition as follows: "It may be stated (1) that a wound in the renal region succeeded by the escape of urine through the wound is conclusive of injury to the kidney; (2) that such a wound quickly succeeded by the discharge *per urethram* of urine heavily mixed with blood, or of pure blood, is almost conclusive, if not quite so; (3) that such a wound succeeded by retention of urine, or lumbar or abdominal pain and dysuria, even without hematuria, is highly suggestive of a superficial wound of the kidney, or of a deeper wound and the blockage of the ureter; (4) that hematuria succeeded by traumatic peritonitis is strong evidence of an injured kidney."

The chief clinical features of a penetrating wound of the kidney, other than the symptoms of rupture of that organ, are: (1) External hemorrhage, (2) greater likelihood of infection from particles of clothing and dirt carried into the wound, (3) frequent involvement of the peritoneum and of the other abdominal viscera, (4) prolapse of the kidney, if the wound is extensive.

Treatment.—The treatment is much the same as that of rupture, except that exploration of the wound for the purpose of cleansing it, and exploratory abdominal section to insure the safety of the other viscera are more often necessary.

Gunshot Wounds.— Although the recorded cases of gunshot wounds of the kidney show a very high mortality—viz., 59 deaths among 85 cases in the War of the Rebellion, and 8 deaths among 15 cases in the Franco-Prussian War—it is evident that this death-rate is due to associated injuries. (Thus Edler [2] collected 20 uncomplicated cases with 5 deaths, and 18 complicated cases with 15 deaths.) Hence, as Küster remarks, "the danger of a gunshot wound of the kidney increases with the velocity of the bullet."

The only special features of these wounds are (1) the explosive effect of high-velocity projectiles—similar to that observed in the other semisolid viscera—(2) the advantage of employing the X-rays to locate the bullet in case its extraction is desirable.

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[1] *Deutsch. Klinik*, 1896, lii, 1, 221.

[2] *Arch. f. klin. Chir.*, 1887, xxxiv, 379.

ANEURYSM OF THE RENAL ARTERY

Morris has collected 19 instances of aneurysm of the renal artery, of which 12 were traumatic in origin. He calls attention to this very rare condition because, apparently, it is always fatal (if of any size) unless the patient submits to operation.

The *symptoms* are tumor, pain, and hematuria. It is remarkable that pulsation is rarely detected. Morris detected a loud systolic bruit in his case, but no thrill. The *diagnosis* is made by operation.

The *treatment* is operative. The aneurysmal sac should be disturbed as little as possible until the pedicle is secured. Albert, Hahn, and Keen have operated successfully; Morris unsuccessfully. A transperitoneal operation presents a better field for securing the renal vessels than does the lumbar route.

RUPTURE AND WOUNDS OF THE URETER

Rupture.—Subcutaneous rupture of the ureter is very rare. Morris [1] finds 24 reported cases, of which he rejects 12 and classifies the others as verified (3), probable (4), and possible (5). Macdonald, of Minneapolis, has added an authentic case.[2] The small size, loose attachments, and projected position of the ureter render it peculiarly likely to escape injury except from a penetrating wound.

It is quite impossible to distinguish rupture of the ureter from rupture of the renal pelvis except by operation.

Wounds.—Accidental wounds of the ureter are even more uncommon. Morris has found only 5 reported cases (2 bullet wounds), and quotes Otis's conjecture that these injuries do not come to the surgeon's notice because the trunk vessels are likely to be punctured.

Operative Wounds.—The ureter, in most instances so safe from the onslaught of the surgeon, is frequently wounded during the course of a hysterectomy. "To-day there are few surgeon's who have done many major operations upon the pelvic and abdominal organs who have not had the misfortune, once or oftener, to divide, or even excise, a portion of a ureter, either through necessity or by accident" (Morris). So common is this occurrence, indeed, that Howard Kelly advises catheterization of the ureters (that they may be readily recognized) as a preliminary to every hysterectomy. Discussion of these preventive measures we leave to the gynecologist, with the assurance that a maturing experience will serve to reduce the number of accidental wounds of the ureter, which thus far has seemed to wax rather than to wane.

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[1] "Surg. Dis. of the Kidneys and Ureter," London, 1900, ii, 332.

[2] *Med. Record*, 1901.

Symptoms.—1. If the ureter is tied off or otherwise occluded the kidney, after going through a preliminary period of congestion and slight dilatation, atrophies without dilatation. In such a case, if the opposite kidney is normal, the accident may never be recognized. On the other hand, even if both ureters are tied off, the complete anuria which results is symptomless up to the last moment, like calculous anuria.

2. If the ureter is divided and the accident passes unrecognized, the position of the wound is usually such that the urine discharges into the vagina and a utero-vaginal fistula remains to be dealt with.

3. If the wound is so situated that the urine is extravasated within the peritoneal cavity, it sets up peritonitis, immediate and general if the urine is bacterial, remote and localized if the urine is clean. The source of the infection is suspected only when urine is discovered in the discharge.

Treatment.—In the early days of pelvic surgery nephrectomy was the only alternative offered to those women who were left with ureterovaginal fistulæ after hysterectomy. But in 1886 Schopf, Fritsch, and Tauffer (twice) each recognized at the time of operation that he had divided the ureter and proceeded to sew the ends together. Thus began the conservative surgery of the ureter, and thus from the mishaps of gynecology has arisen the most brilliant conservative achievement of urinary surgery, the preservation of the healthy kidney whose duct has been severed.

The modern treatment consists of ureteral anastomosis, or, if that is impossible, nephrostomy if the condition of the opposite kidney is indetermined; nephrectomy if it is known to be adequate.

CHAPTER LIV

WOUNDS AND RUPTURES OF THE BLADDER AND URETHRA

WOUNDS OF THE BLADDER

Wounds of the bladder are not common, since the position of the organ protects it from ordinary accidents, inclosed as it is, when in a state of relaxation, by the bony pelvis. Excepting the violence done by instruments in lithotomy, possibly in lithotrity, or during other operations, the bladder is but little liable to injury except when overdistended. It may be perforated by a fragment of bone in fracture of the pelvis. Rising above the symphysis pubis it becomes exposed to incised, punctured, and gunshot wounds. Wounds of the bladder are exceedingly dangerous to life without being necessarily fatal. Bullets and fragments of shell have entered the bladder without producing fatal consequences,[1] and there formed nuclei for calculus, as have also portions of bone. Surgical wounds aside, Bartels [2] was unable to find among 405 reported wounds of the bladder any incised wound. Lacerations of the bladder not communicating with the external wound are, clinically, ruptures.

Symptoms and Prognosis.—The symptoms of wounds of the bladder are comparable to those of rupture (plus an external wound). The *prognosis* depends upon the presence and severity of the complications, the availability of surgical assistance, and the position of the rupture, whether it is intraperitoneal or extraperitoneal. Bartels collected 131 cases of intraperitoneal wounds, of which only 1 survived, while of 373 extraperitoneal wounds only 85 died.

These statistics belong to the preantiseptic period.

Evans and Fowler [3] have collected 25 cases reported since 1877, of which 7 were intraperitoneal injuries with 2 deaths, and 18 extraperitoneal with 2 deaths.

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[1] I have recorded in the *New York Journal of Medicine*, May, 1865, the case of an adult whose bladder was perforated by a bullet during the New York riots in July, 1863, terminating in complete recovery.—Van Buren.

[2] *Arch. f. klin. Chir.*, 1877, xxii, 519, 715.

[3] *Ann. Surg.*, 1905, xlii, 215.

Treatment.—The treatment is immediate incision, suture of the bladder, and packing of the external wound to prevent infection and secondary infiltration. Nothing less than this could be expected to save a patient with an intraperitoneal wound of his bladder, and extraperitoneal injuries are certainly best treated in this way. But if the case is not seen until infiltration has set in, wide incisions, irrigation, and drainage are necessary.

RUPTURE OF THE BLADDER

A bladder, when overdistended by urine, may be ruptured by external violence, and this especially if it be atrophied or thinned by disease, ulceration, or otherwise; or the accident may occasionally happen by the accumulation of urine alone without any recognizable external violence, as in case of stricture. Such a spontaneous rupture is undoubtedly attributable to muscular contraction.

Among the exciting traumatic causes, falls, blows, and crushing injuries, with or without fracture of the pelvis, or even appreciable injury to the soft parts, may be mentioned. The patient is usually intoxicated at the time of injury, the alcohol predisposing him to rupture of the bladder in a threefold way—viz., by causing the bladder to fill rapidly, by obtunding its sensibility, and by facilitating the injury. The rupture may be intraperitoneal or extraperitoneal.

Subperitoneal rupture, in which the fundus of the bladder is torn without lacerating the peritoneum, need not be distinguished, for it either remains extraperitoneal or becomes intraperitoneal.

Intraperitoneal rupture is the more frequent variety. It is caused by a blow upon the hypogastrium bursting the distended organ as a blow bursts a paper bag. There are often no associated lesions. It has been surmised that the fundus yields to the distending force not through any weakness of the bladder wall at that point, but because the intestines give way before it, while below the bladder is supported by the bony pelvis.

Extraperitoneal rupture is almost always associated with fracture of the pelvis.

Mitchell [1] has collected 90 cases, of which 36 per cent occurred on the anterior surface, and most of the others about the neck. Rupture of the sides or base is commonly intraperitoneal.

Rupture of the empty bladder is extremely rare, always extraperitoneal, and due to fracture of the pelvis.

Rupture of the bladder from overdistention preliminary to cystotomy has been reported 10 times.[2] This accident is always avoided if the bladder is distended *after* incision of the parietes.

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[1] *Ann. Surg.*, 1898, xxvii, 151.

[2] Horwitz, *Ann. Surg.*, December, 1905.

Results.—Peritonitis is the almost inevitable outcome of intraperitoneal rupture. As a rule, the urine is infected and the peritonitis immediate. But if the urine is aseptic this peritonitis may be delayed several days; may even fail to appear altogether if the amount of urine extravasated be small.

Extraperitoneal rupture results in cellulitis and suppuration about the bladder. Peritonitis may result as a secondary complication.

Complications.—Fracture of the pelvis can scarcely be termed a complication of rupture of the bladder. The bladder lesion is the complication, since it results from the disintegration of the pelvic ring. In such cases the bladder rupture is usually extraperitoneal.

Rupture of the membranous urethra is sometimes associated with rupture of the bladder as a complication of pelvic fracture.

Symptoms.—All the symptoms of rupture of the bladder may be absent in a given case, or obscured by symptoms due to other injuries.

The symptoms of a classical case have been well summarized by Besley,[1] as follows:

1. At the time of the injury there is immediate severe pain in the abdomen, and sometimes a distinct sense of something tearing or giving way. This is described by the patient as being in the lower part of the abdomen, or occasionally referred to the region of the heart. The severe pain felt at the outset is usually continuous. Marked symptoms and signs of collapse are quite constantly found. . . .

2. The patient is unable to walk, or walks with great difficulty. Records of cases show this to be an almost constant condition.

3. One of the most prominent and constantly present symptoms is the strong desire, accompanied with an inability, to void urine. A few drops of blood or bloody urine usually passes from the urethra. Not infrequently, however, the patients are able to void urine in either an extraperitoneal or an intraperitoneal rupture. Bloody urine was a marked sign in every case of this report.

4. The subsequent course of the disease and the symptoms depend upon the location of the rupture and the direction of the extravasation.

If the tear is intraperitoneal, the course will be that of a peritonitis with obstipation, vomiting, and high pulse and temperature. It must be borne in mind that the temperature curve is only one item, and the presence or absence of fever is not absolutely diagnostic for or against a peritonitis.

When the rupture is extraperitoneal, the symptoms are those due to an extravasation of the urine into the tissues, giving rise to the absorption of the poisonous properties of the urine and the toxins of the accompanying suppuration.

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[1] *Surgery, Gyn., and Obstet.*, 1907, iv, 514.

These symptoms are those of sepsis, with chills, high pulse, irregular temperature curve, headache, and gastro-intestinal disturbances.

Diagnosis.—Rupture of the bladder may be suspected when a patient has received a contusion of the hypogastrium or a fracture of the pelvis and thereafter either passes bloody urine or no urine at all; when a patient in alcoholic stupor shows undue rigidity and tenderness about the hypogastrium and catheterism draws no urine or bloody urine; when a patient known to suffer from a grave bladder lesion complains of sudden severe hypogastric pain and thereafter strives in vain to urinate; when there is fracture of the pelvis and rupture of the urethra.

The diagnosis is verified by a study of the symptoms aided by palpation, urethral instrumentation, and, if necessary, by exploratory operation.

Palpation.—At the outset, palpation of the hypogastrium reveals rigidity and tenderness (which may, however, be due to parietal contusion). Later the space of Retzius may be filled by a doughy sensitive infiltrate (extraperitoneal rupture) or the rigidity and tenderness may extend to the whole abdomen (intraperitoneal rupture).

If the rupture is extraperitoneal rectal palpation may reveal tenderness and infiltration.

Catheterism.—The catheter usually withdraws a little bloody urine. Exceptionally a large amount of urine is obtained that shows blood only to the microscope.

If catheterism is impossible because of ruptured urethra, immediate perineal section should be performed.

Injection Tests.—Injection of air may increase the shock, and is therefore condemned.

Injection of a measured quantity of salt solution, to see whether it all returns, may be employed in doubtful subacute cases; but this test is far from infallible. If the rupture is small or valvelike all the fluid may return.

Moreover, the surgeon should be prepared to follow up the examination by immediate operation if rupture is discovered, since this instrumentation is calculated to spread urine and infection broadcast throughout the peritoneum or the cellular tissues.

Hence, recent writers follow Alexander [1] in condemning this test in acute cases.

Exploratory Operation.—If there is still doubt, the abdomen should be opened in the median line, the space of Retzius explored, and the peritoneum then opened. Recto-abdominal palpation then detects any infiltration about the base of the bladder.

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[1] *Ann. Surg.*, 1901, xxxiv, 209.

Treatment of Rupture.—When the diagnosis is established there is no treatment other than immediate operation; when it is in doubt an exploratory operation affords the quickest and surest means of reaching a conclusion that must be reached quickly if at all. The only contra-indications to operation are shock and grave visceral injuries, and if an infusion of salt solution improves the general condition the operation should be performed even in shock.

The first incision should open the peritoneal cavity through the median line. If an intraperitoneal tear is encountered, it is closed over with a layer of Lembert sutures in the bladder wall, and another in the peritoneum. All accumulations of fluid are then gently mopped up, and the whole lower part of the peritoneal cavity is copiously irrigated with salt solution. Meanwhile the strength of the suture line is tested by filling the bladder with salt solution. If any escapes, the leaky portion of the wound is protected by additional sutures. This test is most essential. In 4 cases mentioned by Walsham [1] the cause of death was leakage through the sutured bladder wound. The abdominal wound is then closed with a single wick of gauze running to the point of rupture. A catheter is tied into the bladder until the seventh day.

If the peritoneum proves to be untorn, the abdominal wound is closed and the bladder opened through a small suprapubic incision. If the hole in the bladder is found presenting, it is sutured, tested, and the external wound drained. But if the rupture is situated at the bladder neck or at some other inaccessible point, it may be treated by suture or left untouched, and drainage may be established through the abdominal wall and the urethra or the perineum.

Prognosis.—Among Mitchell's 90 cases of extraperitoneal rupture of the bladder 37 were operated upon and 24 of these died (64.9 per cent); while of the 53 treated expectantly 51 died (96.2 per cent). Sieur [2] collected 34 cases of intraperitoneal rupture, all operated upon, with the following results:

Operation.	Cases.	Cured.	Died.	Mortality.
Within 12 hours	13	8	5	38.4 per cent.
12 to 24 hours	10	3	7	70 "
24 to 62 hours	11	3	8	72.7 "
Total	34	14	20	58.8 "

Without operation practically all would have died.

These statistics encourage early operation so markedly as to call for no comment. Doubtless the relatively low postoperative mortality of

[1] *Univ. Med. Jour.*, 1895, iii, 200.

[2] *Archiv gen. de méd.*, 1894, i, 129.

intraperitoneal (58.5 per cent),[3] as compared to extraperitoneal rupture (64.9 per cent), may be due to the fact that the immediate gravity of the peritoneal cases enforces early operation, while the slower progress of extraperitoneal ruptures encourage ill-advised delay.

WOUNDS OF THE URETHRA

The urethra may be wounded by traumatism from within or from without. External wounds only concern us here. Internal wounds, whether produced by foreign bodies, by instrumentation, or by internal urethrotomy, find more appropriate exposition under their respective titles.

Punctured Wounds.—The prognosis of a punctured wound of the urethra is generally good. For simple punctured wounds a single irrigation of the wound and the urethra with an antiseptic solution (e. g., permanganate of potassium, 1 : 4,000), followed by careful catheterization for each urinary act during the first one to three days, should result in a cure. If the puncture is merely the central point of a laceration or a contusion of the canal, the treatment must be carried out as laid down for these conditions. Complicating suppuration, infiltration, or fistula requires appropriate treatment, as indicated below.

Incised Wounds.—Clean-cut wounds are very rare in the perineum; they usually implicate the penile urethra, the corpus spongiosum, and often some portion of the corpora cavernosa. The *complications* to be feared are periurethritis (infiltration of urine) with prolonged suppuration and secondary gangrene, traumatic stricture, and fistula. Wounds in the scrotal region are most likely to be followed by severe inflammation, while obstinate fistula is the usual complication of wounds of the penile urethra. The prognosis of stricture, on the other hand, depends on the extent rather than on the situation of the lesion. Stricture does not follow longitudinal wounds of the urethra, but results rapidly from any transverse or oblique wound. When the anterior urethra is completely severed, the cut ends retract within the corpus spongiosum to such an extent that it may be difficult to bring them together again.

Treatment.—Immediate suture is the first indication. It may usually be performed under local anesthesia. If the gaping is slight, satisfactory approximation may be obtained by silk sutures inserted into the skin, the corpus cavernosum, and the deeper part of the mucous membrane without touching the epithelial surface, the wound having been cleansed by copious irrigation. If the wound gaps widely, or the urethra is completely divided, buried catgut sutures or skin-grafting may be employed with intermittent catheterization, or the retained catheter, as in rupture of the urethra.

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[1] Alexander gives 51.1 per cent, Watson, 42.2 per cent.

RUPTURE OF THE URETHRA

This includes all contused and lacerated wounds of the canal inflicted from without, and is by far the most common urethral injury, the lesion usually involving the bulb, rarely the pendulous, and still more rarely the posterior urethra.

Etiology.—1. *The pendulous urethra* is practically safe from injury except during erection; but in that condition it is liable not only to extensive injury, as in fracture of the penis and breaking a chordee, but also, as Guyon insists, to slight tears by bruising during coitus—injuries which, though scarcely noted at the time, may have dire consequences.

2. *Rupture of the bulb* is usually the result of direct violence—falling astride of a beam or some such hard object (in 82 per cent—Kaufmann), a kick upon the perineum, or the jolting of a rider onto the pommel of his saddle.

3. *The posterior urethra* is torn only with fracture, dislocation, or severe strain of the pelvis, or, exceptionally, by excessive direct violence. The membranous urethra is commonly involved, being torn with the triangular ligament, while the prostatic urethra is spared in all but the most extensive fractures.

The *mechanism* of rupture of the bulb has provoked much dispute. When the force is applied obliquely, the canal is crushed against the ischiopubic rami; when from in front, as, for instance, in a fall with the body bent forward, the impact is against the front of the pubes (Oberst, Terrillon); while in certain cases, where the force is applied directly from below, the urethra is probably torn at the sharp edge of the suprapubic ligament (Ollier and Poncet). It is upon this last fact that differences of opinion persist.

Pathology.—The trauma which ruptures the urethra generally spares the surrounding soft parts. As the injury is usually the work of a blunt implement, the skin and the muscles are not torn, and the superficial aspect is, frequently enough, that of a mere bruise or abrasion.

The canal itself may be merely bruised, or more or less completely torn asunder. In the posterior urethra complete laceration is the rule, the canal being broken, as it were, in the grip of the triangular ligament. In the bulb complete laceration through part of the circumference of the canal is the rule; but the roof is usually spared—a point of considerable importance in subsequent catheterization. In the anterior urethra the milder injuries consist in mere interstitial hemorrhage [1]—contusion, as it were—of the corpus spongiosum, with perhaps slight

[1] The possibility of this condition, as well as its clinical importance, has been warmly debated. Baron (*Presse méd.*, 1898, i, 250) sums up the evidence at hand, and shows that a simple contusion, without any break in the mucous membrane, may perfectly well be the starting-point for traumatic stricture.

lacerations of the mucous membrane or of the sheath of the spongy body.

Symptoms.—The cardinal symptoms of injury to the urethra are pain, tenderness, bleeding, interference with urination, and tumefaction.

The *pain* is sharp and occurs at the moment of rupture. It may be the only symptom of interstitial rupture due to a jar to the erect penis. As it abates rapidly the patient may pay but little attention to it, though even a slight injury may lay the foundation for traumatic stricture. The pain recurs with each act of urination for a longer or shorter time, according to the gravity of the injury and the temperament of the person. *Tenderness* exists primarily at the point of injury and later in the course of inflammation.

Bleeding from the meatus is a constant symptom. It is lacking only in the rare cases in which the mucous membrane is uninjured. It occurs quite independent of urination (urethrorrhagia), its quantity not indicating the severity of the lesion. The unbroken skin usually prevents external (perineal) hemorrhage, though a hematoma of some size is not unusual. Hematuria combined with urethrorrhagia indicates an injury to the posterior urethra.

The *disturbance of urination* varies from the hesitancy excited by the pain of the milder cases to complete retention. This latter, indeed, is the usual condition, and is due to contraction of the lacerated urethra and to spasm of the cut-off muscle, rarely to hematoma of the corpus spongiosum. The retention, if not speedily relieved, is intensified by the congestion and inflammation about the wound.

Tumefaction, primarily the effect of hemorrhage, secondarily of urinary infiltration and suppuration, follows the fascial spaces. The tumor after injury to the pendulous urethra is usually a circumscribed one within the corpus spongiosum, but may follow the course of a perineal infiltration and extend throughout the scrotum and penis. Effusions within the triangular ligament are retained there to form a tense perineal tumor, which may burst either forward or backward, while injury to the prostatic urethra leads to infiltration of the recto-vesical space. (See Chapter XXIII).

Diagnosis.—The diagnosis of the extent of injury is not easy. Immediate interference with urination, which always follows complete rupture, may be caused by spasm or by retained clots. Catheterization, impossible if there is complete rupture, may fail even in milder cases. It is sufficient, however, for practical purposes, to diagnose the severity of the case according to the symptoms, as indicated below. Diagnosis of the position of the injury may be made with a fair degree of accuracy from its etiology, the location of the tenderness and tumor, and the presence or absence of hematuria. The presence of urethrorrhagia, while establishing the existence of rupture of the urethra, does not ex-

clude rupture of the bladder; but a positive diagnosis of the latter condition is usually practicable.

Course and Prognosis.—Guyon's classification is convenient as offering the most precise indications for treatment. It is as follows:

1. *Mild injuries to the pendulous urethra,* in which the trauma is succeeded by a sharp pain, slight bleeding, and a few painful urinary acts, are not likely to be followed by any serious consequences, except traumatic stricture, which is almost inevitable.

2. *Moderately severe injuries to the pendulous urethra* are characterized by free bleeding, painful and impeded urination, and a hematoma of some size. The chief danger here lies in infiltration and periurethral suppuration.

3. In the *severe injuries* and in most *perineal cases* complete retention is the prominent symptom. It can rarely be relieved otherwise than by external urethrotomy.

In any case traumatic stricture may be predicted—a condition formidable both in its rapidity of onset and its rebelliousness to treatment. (See Chapter XXIII.)

The mortality from rupture of the urethra is low. Terrillon records 12 deaths in 170 cases, chiefly from uremia, septicemia, and hemorrhage.

Treatment.—1. For *mild injuries to the pendulous urethra* expectant treatment should be employed. Rest in bed, free purgation, and the internal administration of hexamethylenamin should be supplemented by injection twice a day of 3 to 5 c.c. of silver-nitrate solution (1:2,000) or protargol (1:1,000) into the anterior urethra. Catheterization is unnecessary and absolutely contra-indicated. Extravasation or suppuration must be met by prompt incision. Three days after the symptoms have subsided the patient may be pronounced free from all dangers except stricture, against which he must be warned, and for which treatment is to be instituted on its appearance. The contraction usually begins within six weeks of the time of injury.

Perineal rupture, however mild, demands immediate external section to avert deep resilient stricture.

2. *Moderately severe anterior injuries* represent, in a general way, slight lacerations, in which one may hope to avoid infiltration by keeping the urethra cleansed, as above, and preventing any contact of the urine with the wound. A small (Nos. 7 to 15 French) rubber or elbowed catheter should be introduced every six hours or tied in.

3. *Perineal ruptures* and all *severe injuries to the pendulous urethra* call for immediate external urethrotomy and suture. Palliative measures, such as suprapubic aspiration, catheterization, or the retained catheter, cannot save the day. Aspiration may be useful to relieve the distention of the bladder and thus to gain time, but the retained catheter is worse than useless. It serves only to invite infiltration, while re-

peated catheterization is impossible as soon as congestion sets in. On the other hand, perineal section relieves the retention at once, while suture of the divided ends of the urethra affords the surest means of preventing resilient traumatic stricture. Though opinions may vary as to whether stricture can be absolutely prevented by this operation—and I believe that in some cases it can—there can be no doubt but that the scar after operation is far less retractile, and proves amenable to treatment by sounds.

URETHRO-RECTAL FISTULÆ

Urethro-rectal fistulæ are very rare. They commonly arise from the prostatic urethra. They are caused by trauma (catheterization, prostatectomy), abscess of the prostate, tuberculosis, or malignant disease. Tubercular and cancerous fistulæ are quite incurable and need not concern us. Traumatic and inflammatory fistulæ, on the other hand, commonly recover. I once opened a prostatic abscess into the rectum only to find that it had just burst into the bladder. The resultant fistula healed in four weeks. I have thrice opened the rectum during prostatectomy. Each time the fistula healed spontaneously.

Treatment.—Cases that do not recover spontaneously require operative interference. Preliminary cauterization of the fistula may be tried, but success need not be anticipated from such treatment. As a preliminary measure all strictures of the urethra must be cured. Whatever operation is performed should include division of the sphincter ani, preferably by posterior proctotomy. By these means the urethral and rectal channels are freed from all impediments.

CHAPTER LV

CONGENITAL ABNORMALITIES OF THE URINARY ORGANS

ABNORMALITIES OF THE KIDNEY

The abnormalities of the kidney are either—

1. Abnormalities of Form (Congenital Malformations).
2. Abnormalities of Number, or
3. Abnormalities of Position (Misplaced Kidney).

Since operations upon the kidney have become so frequent each variety has assumed a practical importance.

Frequency.—Abnormalities of the kidney are very rare. Morris [1] has collected the records of 11,168 portmortem examinations at the Middlesex Hospital and Guy's. Excluding movable kidneys, 16 cases of double ureter, and 53 cases of acquired atrophy and small cirrhotic kidneys, his cases may be tabulated thus:

Congenital atrophy (unilateral)	11 cases.
Fused kidney	1 case.
Horseshoe kidney	16 cases.
Lobulated kidney (4 bilateral)	9 cases.
Malformed kidneys (1 bilateral)	6 cases.
Misplaced kidneys	10 cases.

About 1 case in 211.

Congenital Malformations

Variations in the size of the kidney are interesting only when they amount to atrophy. Apart from these malformations, we may consider malformations without union and malformations associated with fusion or union of the two kidneys.

Simple Malformation.—Slight irregularity in the shape of the kidney, a greater or less persistence of fetal lobulations, is not uncommon and has no surgical interest. Considerable malformation of the kidney is usually associated with displacement, and is of interest in the latter connection. Bergmann [2] states that malformed kidneys are peculiarly subject to tuberculosis.

Fusion.—(See Abnormalities in Number.)

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[1] "Surgical Diseases of the Kidney and Ureter," 1901, i, 32.

[2] *Deutsche Chir. von Billroth u. Lücke,* 1896, iii, i, 113.

Abnormalities in Number

Morris recognizes five subvarieties—viz.:

A. Single, or unsymmetrical kidney, when one is entirely absent.

B. Solitary or fused kidney, when the two kidneys are massed together.

C. Imperfect development, or atrophy of the kidney.

D. Absence of both kidneys (no clinical significance).

E. Supernumerary kidneys.

In each of the first three subvarieties there is but one kidney, yet embryologically the conditions differ widely. In class *A* one kidney is entirely absent; in class *B* both kidneys are more or less fully developed and united; in class *C* one kidney is never sufficiently developed to perform its functions.

Single Kidney.—Single kidney is very rare. Morris has collected records of 10 instances among 24,542 autopsies. The kidney is hypertrophied and may be situated normally or displaced downward. The ureter is wanting on the opposite side. The absence of one kidney is not necessarily a great evil, for Newman has recorded 17 cases of patients with this abnormality living beyond the sixtieth year. But it is of paramount importance should the question of nephrectomy arise.

Fused Kidney.—Fused kidney may be horseshoe-shaped, completely fused, or irregular in shape. The two latter forms are extremely rare. In each the kidney has two ureters running from it into opposite sides of the bladder, and may be situated normally, displaced downward, or lying in the median line.

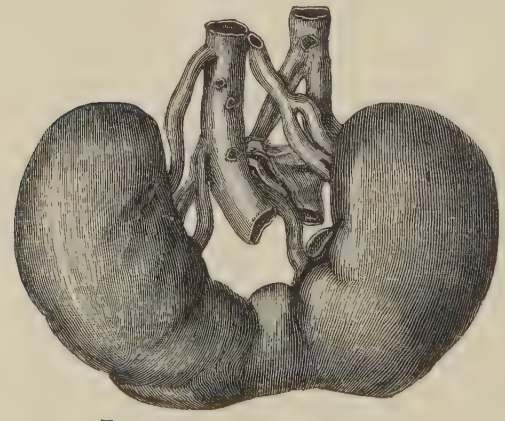

Fig. 113.—Horseshoe Kidney.

The horseshoe kidney (Fig. 113) is the most common of all renal abnormalities. Morris noted it 19 times among 18,244 autopsies; Preindlsberger[1] 6 times among 1,344 autopsies; and Socin[2] 5 times among 1,630 autopsies—in all, 30 cases among 21,218 autopsies (1 in 707). The fused organ is made up of two fairly normal kidneys lying low in the loin, and more or less intimately united by a band of renal

[1] *Wien. klin. Rundschau*, 1901, xv, 197, 215.

[2] Quoted by Bergmann, *op. cit.*, p. 117

tissue running across the median line and connecting the lower poles of the two organs. (In one of Socin's and one of Preindlsberger's cases the upper poles are united instead of the lower ones.) The great vessels habitually lie behind the central mass, while, as a rule, the ureters descend in front of it. There are usually two separate and normal pelves and ureters, but ureteral and vascular abnormalities often occur. Since the possibility of partial nephrectomy has become generally recognized, the horseshoe kidney has lost its terrors. A contemplated nephrectomy need not be abandoned if this condition is encountered. Resection of the affected half of the organ may be performed, although, of course, the other half must be spared.

Atrophy of the Kidney.—Atrophy of one kidney may be congenital or acquired. Congenital atrophy is infrequent, while acquired atrophy, the result of interstitial nephritis or of ureteral obstruction, is common. The existence of this condition enforces the rule, *Never perform nephrectomy unless you are sure that the opposite kidney is present and functionating* (p. 91).

Supernumerary Kidney.—Supernumerary kidneys are most uncommon. Morris records 3 cases, of which 2 were examples of small accessory organs lying near one of the kidneys. The third case, reported by Watson Cheyne,[1] is unique in that the supernumerary kidney lay at the pelvic brim and was found during a laparotomy.

Misplaced Kidney

A misplaced kidney is by no means a movable or floating kidney (p. 488), though the two conditions may coexist. A fused kidney is usually misplaced, a misplaced kidney often misshapen. Usually only one kidney is affected. The misplaced organ commonly lies near the sacroiliac synchondrosis, exceptionally in the true pelvis or the opposite loin. The condition is usually congenital, though a movable kidney may become fixed in an abnormal position.

The clinical features of misplaced kidneys are: (*a*) the danger of mistaking them for abdominal tumors, and (*b*) the painful and pathological effects of pressure upon the misplaced organ itself as well as upon the adjoining organs. Hochenegg[2] records 9 nephrectomies for this condition.

URETERAL ANOMALIES

Anomalies of Number.—Variations in the number of the ureters are attributable to anomalies in the kidneys. Thus, when one kidney is absent its ureter is missing as well. A fused kidney, however,

[1] *Lancet*, 1899, i, 215.

[2] *Wien. klin. Wochenschr.*, 1900, xiii, 4.

commonly has two distinct pelves and ureters. When a kidney has two or more separate pelves the ureters are correspondingly increased in number. These multiple ureters usually become fused in the upper part of their course. If they remain separate until they reach the bladder, they terminate by two distinct orifices placed close together. The ureter that arises from the lower pole of the kidney terminates normally at the angle of the trigone. That which originates in the upper pole crosses behind its fellow and terminates below it, abnormally.

Thus the ureter may be—

1. Double in its upper part (most common type).
2. Double in its lower part (alleged by Kapsammer, denied by Albarran).
3. Double throughout.

Anomalous Point of Origin.—When a ureter rises from any but the most dependent point in the renal pelvis it may so interfere with the outflow of urine as to cause hydronephrosis (p. 506).

Anomalous Implantation.—The ureter may empty into the urethra, the rectum, or the seminal passages (or the vagina in the female). Such cases are rare. The subject is discussed by Beuckhiser[1] and Olshausen.[2]

Dilatation of the Lower End of the Ureter.—(*Intravesical Ureteral Cyst*).—This rare condition is due to constriction of the vesical orifice of the ureter. Stricture at this point causes a back pressure that is chiefly felt in that part of the ureter which underlies the vesical mucous membrane. The ureteral wall gradually stretches at this point until there is a large cyst projecting into the bladder. Hydronephrosis may result. The cyst may grow large enough to obstruct the urethra, or even, in the female, to protrude from the meatus (prolapse of the vesical mucous membrane). On the other hand, the pouch may become inverted into the ureter (Delore). Englisch has collected 23 cases of such cysts, in 7 of which the ureter terminated in an abnormal locality.

Congenital stricture occurs at the lower end of the ureter. It causes the condition just described.

Angulation.—Kinking of the ureter over a branch of the renal artery or vein probably occurs only as the result of nephroptosis.

CONGENITAL ANOMALIES OF THE BLADDER

Double bladder, a condition in which the bladder is either divided into lateral halves by a central partition, or gives off one or two large lateral cavities, or is divided by a transverse partition, is very rare. The

[1] *Zeitschr. f. Geb. u. Gyn.*, 1899, xli, 413. [2] *Ibid.*, 1899, xli, 423.

anomaly is a curious one and has certain clinical significance in that it may give rise to troubles similar to those caused by acquired diverticula, with which, indeed, it is often confused. *Absence of the bladder* is also very rare.

Exstrophy of the Bladder

Exstrophy or extroversion of the bladder (ectopia vesicæ) is far more common in the male than in the female. Thus, of the 49 cases collected by Pousson,[1] 37 were men and 12 women. In the female it is of less importance, as it may be more easily concealed, and does not prevent performance of the sexual act. Cases of pregnancy and successful delivery at term are recorded.

The deformity is an arrest of development in the median line analogous to harelip, and is found in different degrees. In a type case the lower part of the front wall of the abdomen and the front wall of the bladder are absent. The pubic bones are more or less widely separated from one another, their ends being united by a strong band of fibrous tissue. The posterior wall of the bladder, pressed out by the intestines, forms a mottled, red, tomatolike tumor, occupying the position of the symphysis pubis. Inguinal hernia of one or both sides is not uncommonly present, either partial or extending down into the scrotum, which is usually normal, containing the testicles. The penis is rudimentary, and affected by complete epispadias. The ureters are sometimes greatly dilated, forming, as it were, rudimentary bladders. The pathology and etiology are given in detail by Connell.[2]

The above description applies to a type case. There may be variations in the absence of herniæ, in a normal union of the pubic bones, in the amount of the protrusion, etc. Ordinarily in the adult the mass reaches the size of the palm of the hand. With complete exstrophy there is also always complete epispadias. A condition analogous to exstrophy may exist where the bony union of the pelvis is lacking, but the anterior walls of the abdomen and bladder are perfect. Here there is a sort of hernia of the bladder forward. In such cases there is always some malformation of the external organs of generation.

In exstrophy of the bladder the patient's condition is miserable indeed. The mucous membrane covering the protruded posterior wall of the everted bladder is inflamed, thickened, ulcerated, and covered by decomposing stringy mucus, the whole bathed in ammoniacal urine.

The integument of the abdomen and thighs becomes excoriated and inflamed. The friction of garments in walking only serves to aggravate the existing difficulties, and the sufferer is in a truly pitiable condition.

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[1] *Guyon's Annales*, 1888, vi, 94, 155, 244, 337, 409, 471, 536, 615.

[2] *Jour. Am. Med. Assoc.*, 1901, xxxvi, 637.

By pressing back the inflamed bladder a small prostate is exposed, lying at the angle of the penis and the vesical tumor, and upon it the verumontanum and the ejaculatory ducts may be plainly seen. These patients have erotic fancies and seminal emissions, but they are incapable of full erection or of perfect sexual intercourse.

The possibility of years of such severe vesical catarrh without any ascending infection of the kidney enforces the lesson that the ureteral sphincters are the true guardians of the kidneys, and that ascending infection does not occur unless these portals are forced by the back pressure of urinary retention. Yet in the long run the inflammation of the exstrophied bladder does extend up the ureters to the kidneys and the patient thus usually meets his death.

Treatment.—*Palliative treatment* consists in wearing an appropriate urinal. No urinal can be well arranged for an infant or a young child, and at this time vaselin, hot water, and dusting powder are our only arms against the disease. In later life Earle's or Collin's urinal may be worn. These consist of a metallic shield, preferably of silver, sufficiently bulged to contain the protruding vesical wall without coming into contact with it. The edge is rounded off so as to make for itself, by pressure, a deep groove around the vesical tumor. From the lower part, which is slightly bellied downward, extends a tube upon which is fitted a long, flat rubber bag, to be worn strapped to the thigh, and to serve as a reservoir for the urine (Fig. 114).

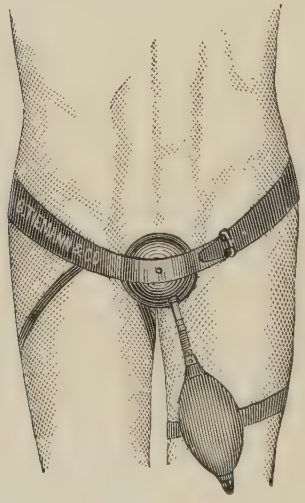

Fig. 114.

The bottom of the bag terminates in a metallic screw, which can be removed to allow the urine to drain off. The metallic shield above is held in place by a truss, which serves at the same time to retain any hernial projections in the groin. The instrument may be kept clean by a weak solution of formalin.

Choice of Treatment.—Palliative treatment is always unsatisfactory, yet it may be employed by those who object to operation, for operative treatment is almost equally unsatisfactory. We still await the genius who shall give us a reasonably safe and certain cure for this condition. Most of the autoplastic methods are safe, but their results are scarcely worth the having. Maydl's operation does not give much better results. If the patient is cured by this operation he holds his urine from four to six hours, a result boasted by no other procedure. Yet the operation is a serious one. Its 13 per cent reported mortality is prob-

ably an underestimate. It is impossible yet to judge how long the kidneys will withstand infection. But, such as it is, Maydl's (or Peters's) operation is the best we have.

After the urinary stream has thus been diverted, the bladder mucosa is excised, the recti brought together, and an effort made to form a presentable penis and urethra.

Urachus Cyst, or Fistula

Toward the middle months of intra-uterine life the urachus (the canal connecting the bladder with the umbilicus) becomes obliterated. Exceptionally, it remains patent throughout or at one extremity. This patency gives rise to a urachus cyst,[1] or fistula,[2] as the case may be. Urachus cyst is exceedingly rare. I have seen one in an adult which formed a large, irregular, fluctuating, hypogastric tumor.

Urachus fistula is commonly a congenital condition, and is usually caused by urethral obstruction. Certain cases of persistent permeability of the urachus without any obstruction of the natural urinary passages are quite inexplicable. The urachus may open in adult life as a result of urethral obstruction, but doubtless this does not occur unless there has been some congenital defect in the closure of the canal. Urachus fistula may be distinguished from fistulæ resulting from the bursting of an abscess or from malignant infiltration.

The treatment of urachus cyst, or fistula, consists in the excision of the canal or cyst after the urethral obstruction has been removed. Indeed, some fistulæ have been closed by merely removing the obstruction and cauterizing the canal by injections of alcohol or other irritants.

ATROPHY OF THE PROSTATE

Atrophy of the prostate is uncommon. It occurs congenitally or after the organ has been materially injured by abscess, stone, or trauma. Physiological atrophy of the prostate occurs in a certain proportion of old men. This atrophy Thompson observed 11 times among 164 persons over sixty years of age. Messer met with it 20 times in 100 cases (von Frisch), and others give still higher estimates.

The prostate fails to develop in eunuchs, and many authors believe that it atrophies after castration in later life. Idiopathic failure of development has also been observed.

In the atrophied prostate the glandular tissue is shrunken and wasted, and the stroma is but little affected.

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[1] Weiser, *Annals of Surg.*, October, 1906.

[2] Binnie, *Jour. Am. Med. Assoc.*, 1906, xlvii, 109.

Symptoms.—Both enuresis and retention have been attributed to prostatic atrophy; but, as a matter of fact, it causes no symptoms.

MALFORMATIONS OF THE URETHRA

The urethra is subject to arrest and error of development, but is not often seriously deformed. Among curiosities of deformity may be mentioned abnormal position of the meatus on the side of the glans penis; termination of the ejaculatory ducts in a separate canal, running along the dorsum of the penis and opening behind the glans [1] (gonorrhea of this canal has been noted); and termination of the urethra in the groin.[2] Le Fort [3] has collected and classified the different varieties of fistula of the penis and the so-called double urethra, and shows that the second urethra is always a blind pouch, usually a prolongation of the lacuna magna. In fact, double urethra does not exist, except with double penis.

All these deformities, dependent upon excessive and unnatural development, are exceedingly rare. Deformities caused by a defect of development are more common. Either the canal is obstructed or it is not closed in. In the former case the junctions among the various parts of which the canal is formed are incomplete (atresia—congenital stricture); in the latter the closure of the walls is defective (hypospadias—epispadias).

Atresia.—Atresia, commonest at the meatus, may occur at any part of the canal. Indeed, the entire urethra may be replaced by a fibrous cord. The prostatic urethra is never obstructed.

The obstruction is usually but a thin membrane which may be punctured and the orifice kept patent until it heals, after which no further trouble need be anticipated. If, however, the urethra is imperforate for some distance, it may be punctured with a small trocar, but only after the internal segment has been accurately located by external urethrotomy, or, if the membranous urethra is also involved, by suprapubic cystotomy. In these cases the urachus often remains patent, and the patient urinates through it. Removal of the urethral obstruction is soon followed by closure of the urachus. Englisch [4] has furnished a contribution to this subject. The stricture liable to ensue upon puncture of the diaphragm or of a band must be combated by the usual methods. Major surgical procedures are best delayed, if possible, until the patient has attained his sixth or eighth year.

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[1] Cruveilhier, "Traité d'anatomie descriptive," Paris, 1865, vol. ii, fasc. 1.

[2] Haller, quoted by Pitha, "Krankheiten der männlichen Geschlechtsorgane," 1864.

[3] *Guyon's Annales*, 1896, xiv, 624, 792, 912, and 1095.

[4] *Arch. f. Kinderheilk.*, 1881, ii, 85 and 291.

Congenital Stricture.—Congenital stricture, usually of the meatus, is so common, and has such a direct bearing upon the treatment of the so-called organic stricture, that it is considered in that connection.

Dilatation of the Urethra.—Bokay [1] has collected 14 cases of congenital urethral diverticula, only 3 of which were due to stricture.

Hypospadias

Hypospadias is that form of imperfect development of the urethra in which the canal terminates in an opening in its lower wall instead of extending to its normal termination in the end of the glans penis. There are three degrees of hypospadias: (1) *balanitic hypospadias,* in which the urethra opens on the lower surface of the glans or at the peno-balanitic junction; (2) *penile hypospadias* (peno-scrotal and scrotal hypospadias), in which the canal opens on the under surface of the penile urethra, usually at the peno-scrotal angle; and (3) *perineal hypospadias,* in which the urethra terminates in front of the triangular ligament and opens in the perineum. Thus hypospadias always occurs in front of the cut-off muscle, and, no matter how extensive it may be, the patient always has control over the escape of urine. Hypospadias at the peno-scrotal angle is more common than the perineal variety, and most frequent of all is balanitic hypospadias. That part of the urethra lying between a hypospadial opening and the meatus is usually absent or impervious, but may be patulous for a short distance in front of the opening on the floor of the urethra, or even up to the meatus.

Hypospadias, as commonly encountered in practice, consists in an absence of the frenum preputii and a flaring open of the meatus inferiorly, or an opening in the floor of the canal within a few lines of the natural meatus, the position of which latter is usually marked more or less perfectly in its usual site. The hypospadic urethral orifice is always contracted. With penile hypospadias there is usually some downward curvature of the penis, and not infrequently adhesion of the penis to the scrotum. The under surfaces of the corpora cavernosa are not developed, the fibrous sheath of the penis is thickened and too short beneath, so that the condition may be called one of permanent physiological chordee. The penis, freed of all cutaneous and urethral attachments, cannot be straightened until the fibrous sheaths of both corpora have been transversely incised beneath, and sometimes not then until the fibrous septum has been incised. The penis, usually small, is sometimes completely buried in the scrotum. With perineal hypospadias the scrotum is bifid, and the penis is usually very imperfectly developed, imperforate, and looks like a large clitoris. The bifid scrotum passes very

[1] *Dermatolog. Zeitschr.*, 1900, vii, 721.

well for a vulva, and in this way most of the pseudo-hermaphrodites are formed.

Etiology.—Hypospadias is usually regarded as a simple arrest of development in a portion of the lower wall of the urethra, its lateral halves failing to unite in the median line. In favor of this view are the manifest hereditary tendency to this deformity seen in some cases, and the fact that at two months the embryo has hypospadias normally. The scrotum has not yet united, and if natural development ceases here the last degree of hypospadias results. It may be urged that this theory does not explain the incurvation of the penis, nor its adhesion to the scrotum, nor the scarlike contracted appearance of the orifice. To explain these facts Kaufmann [1] advances the theory that hypospadias and epispadias are examples of congenital fistula dependent upon imperfect union of the penile and the balanitic urethra. These two portions of the canal, it is known, are developed separately, and if imperfectly approximated atresia at the peno-balanitic junction may result. Now, Kaufmann supposes that the urine secreted by the fetus may break either through the obstruction, leaving congenital fistula, or through the floor of the canal, producing hypospadias, or through its roof, thus causing epispadias. Even supposing that this theory explains incurvation and adhesion (which it does after a fashion), it can scarcely explain malposition of the urethra in epispadias, or exstrophy of the bladder, with nonunion of the symphysis pubis—phenomena so closely related to epispadias that no theory which does not elucidate them can be invoked to account for the urethral deformity. And why, moreover, does not the urine find a free vent through the urachus as it does when the urethra remains closed? In short, Kaufmann's theory, though ingenious, is insufficient.

Symptoms.—Balanitic hypospadias is unimportant; many patients have it without being aware of the fact, while the greatest inconvenience it produces is a slight imperfection in erection and a dribbling at the end of urination. With penile or perineal hypospadias, however, the patient may be forced to urinate in a squatting posture to keep from wetting himself, erection may be very imperfect, and there may be impotence from inability to throw the semen into the vagina. An associated inconvenience is the necessity of enlarging the contracted meatus, in order to introduce dilating instruments, in case of stricture.

Treatment.—For *balanitic hypospadias* no treatment is actually necessary unless a meatotomy to permit the introduction of instruments into the urethra.

But if the patient demands radical operation, Beck's procedure should be employed.

For penile and perineal hypospadias operation is always required.

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[1] *Deutsche Chirurgie*, l, a., 60.

Epispadias

Epispadias (*ἐπὶ, above; σπάζω, I separate*) is a fissure of the superior wall of the urethra with ectopia of the canal (Guyon). It is extremely rare. According to Baron,[1] epispadias occurs once for 150 cases of hypospadias, but Marshall did not find a single case of epispadias in examining 60,000 conscripts.[2] The epispadias may be balanitic or penile, or the urethra may be entirely laid open. This complete epispadias is almost always accompanied by exstrophy of the bladder. The epispadic orifice is large, and sometimes the finger may even be passed through it into the bladder. The prepuce forms a knob of loose tissue below the glans. The penis is short and thick, or small and more or less deviated. It is usually adherent to the scrotum, sometimes practically buried in it. The pubic bones may be separated even when there is no exstrophy of the bladder, and there may be hernia of that organ without exstrophy.

Etiology.—The observations made upon the etiology of hypospadias apply equally well to this condition. Epispadias is certainly an arrest of development in the upper wall of the urethra, but it is still a matter of hypothesis how the urethra gets above the united corpora cavernosa; for even when the genital buds which are to form the corpora cavernosa are still separate at the fortieth day of fetal life, the urethra is beneath them. With exstrophy of the bladder, where the lower portion of the abdominal wall is lacking and the pubic bones do not come together, it is easier to understand how the roof of the urethra may be wanting throughout.

Symptoms.—The symptoms consist in the functional derangement of micturition, erection, and emission, as in hypospadias; but it is to be noted that incontinence of urine, which never complicates hypospadias, is usually the main feature of severe cases of epispadias, and this cries out for operation more loudly and incessantly than even the most aggravated symptoms of hypospadias. Unfortunately, it is precisely here where operations are most in demand that they accomplish least.

Treatment.—For the milder cases, uncomplicated by the loss of sphincter power, the counsel to bear their woes patiently is a good one. The methods hitherto employed to relieve this condition—even the favored procedures of Thiersch and Duplay—are tedious and fraught with failures. In view, however, of the success of the Nové-Josserand operation for hypospadias, I should be tempted to try it for simple

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[1] Dolbeau, *op. cit.*, p. 11.

[2] Englisch (*Bull. méd.*, Paris, 1895, ix, 153) has reported a case of complete separation of the penis into lateral halves, each corpus cavernosum forming a penis by itself, and the urethra opening between them.

penile epispadias. In addition to the changes obviously necessary to adapt the operation to epispadias it would be necessary to divert the stream of urine by ureteral catheterism, and it might seem advisable to connect the new and the old urethra by continuing the graft into the outer extremity of the epispadic urethra previously denuded. I see no reason why the Nové-Josserand operation should not succeed when thus applied to the upper surface of the penis as well as it has undoubtedly succeeded on the opposite side of that organ.

When the sphincter is lost it cannot be replaced. If there is exstrophy of the bladder, that deformity requires attention.

The complicating adhesions, torsion or flexion of the penis, must be dealt with here, as in hypospadias, by liberating incisions of the skin and the sheaths of the cavernous bodies.

CHAPTER LVI

DISEASES OF THE SCROTUM

ANATOMY

The *scrotum* is a pouch formed of skin and of muscular and connective tissue. Its function is to contain and support the testicles. It is developed from lateral halves which unite centrally in the raphe, a raised line continuous with the raphe of the penis and that of the perineum.

The integument of the scrotum is delicate in structure, covered with a few hairs, and likely to become pigmented at puberty. The sebaceous glands are very large.

The dartos is a layer of unstriped muscle firmly attached to the integument, and reflected inward from the raphe, to form the septum scroti. On exposing the scrotum to the air, the vermicular contractions of this muscle can be readily seen. They occur under the influence of cold or fright, and during the venereal orgasm. In youth, especially in winter, the dartos is habitually contracted and holds the testicles well up under the pubes. The ancient sculptors did not fail to notice that contraction of the scrotum was a mark of general as well as of sexual vigor. In the aged and infirm, on the other hand, especially during the summer, the muscle relaxes, allowing the testicles to hang low, supported mainly by the spermatic cords.

The septum scroti is pervious to fluids, so that serum or infiltrated urine can find its way readily from one side to the other. *The lymphatics* of the scrotum are large and numerous and lead to the inguinal glands.

The connective tissue within the scrotum, like that of the penis, is practically devoid of fat. The muscular dartos, described above, is the only layer of importance. The space between it and the testicle is filled with a loose mesh of fascia within which run the scattered fibers of *the cremaster muscle,* and beneath which the infundibuliform fascia, derived from the transversalis fascia, forms the investment of the spermatic cord.

ANOMALIES

The scrotum develops independently of the testicles, but if the latter fail to descend it remains rudimentary.

Failure of union between the lateral halves of the scrotum constitutes one of the features of pseudo-hermaphroditism.

CUTANEOUS DISEASES

The scrotum may be affected by most of the diseases of the skin. Only those that are modified by their position deserve notice.

Eczema.—Eczema attacking the scrotum and the surrounding parts is sometimes excessively obstinate and prone to relapse.

Acute eczema sets up an enormous edematous swelling, resembling that seen in general anasarca.

Intertrigo.—Intertrigo occurs in children and in fat men of rheumatic habit. Much can be done to prevent it by scrupulous cleanliness, and the use of a suspensory bandage to keep the cutaneous surfaces apart. To overcome the hyperemia, rest, cleanliness, and exposure of the parts to the air are speedily effective in mild cases. If the surface is moist and excoriated, it should be dusted with equal parts of finely powdered oxid of zinc, camphor, and starch, or it may be dressed with the oxid-of-zinc ointment or with a solution of sulphate of zinc. A strip of old thin linen should be used to sling up the scrotum and keep the cutaneous surfaces apart. Later, when the parts are dry, compound tincture of iodin, at first considerably diluted with water, locally, will hasten the cure. Avoidance of stimulating food and drink, to render the secretions less irritating, is advisable. Turkish baths avail much.

Pityriasis.—In men with a delicate skin, especially in summer, there is often a slightly brown discoloration of the thigh and the scrotum, where the two surfaces lie habitually in contact, caused by a vegetable parasite in the upper layers of the epidermis. It sometimes gives rise to a mild local erythema and considerable itching. A few applications of the compound tincture of iodin diluted to half strength, and painted on after the affected skin has been washed with soap and dried (to remove the fat from the scales and spores), will cure the discoloration and the itching. Sulphurous acid does well.

Eczema Marginatum.—This is another parasitic disease, affecting the scrotum, thighs, mons veneris, and buttocks. It is not an eczema, but a herpes tonsurans vesiculosus—a combination of herpes tonsurans and intertrigo, as proved by Pick.[1] The eruption commences

[1] *Archiv f. Derm. und Syph.*, 1, iii, 443.

in one or more small, round patches, red, elevated, and itchy, just where the scrotum habitually lies in contact with the thigh. It spreads circumferentially, healing in the center. The border of the eruption is sharply defined, and forms the distinctive feature of the disease. It is composed of papules, vesicles, excoriations, and crusts. The parts within this festooned border over which the disease has passed are left of a brown color. Often, little heaps of dried-up scales lie here and there upon this surface. Patches of eruption break out in the neighborhood or within the border, and behave exactly like the patches first constituting the disease. The affection is slow in getting well and tends to relapse. Friction and moisture of the parts, together with the parasite, are necessary for its production. Among the scales scraped from the margin, the microscope may detect the moniliform filaments and spores of the tricophyton of Malmster. In certain stages of the disease the parasite is difficult to find.

Treatment.—Dilute lead-water or oxid-of-zinc ointment may be used locally at first if there be much inflammation of the skin, to be followed by parasiticide lotions, or the latter may be commenced with at once. The best of these is a mild solution of corrosive sublimate (1:10,000), which should be kept constantly applied. Sulphurous acid, pure, is an excellent parasiticide; or an ointment of turpeth mineral (hydrarg. sulph. flav.) 2 per cent to 4 per cent may be used. Treatment should be kept up for some time after apparent cure, as relapses are the rule, and can only be averted in this way.

Pruritus Genitalium.—This, like other purely pruriginous skin affections without eruption, is excessively obstinate, the sufferers are usually rheumatic or gouty subjects, and any dietetic or hygienic errors seem liable to induce or aggravate the disorder. After the exclusion of animal or vegetable parasites the treatment consists in hygienic and dietetic precautions, with the internal exhibition of alkalies, and, if need be, tonics. Turkish and Russian baths are often very serviceable.

The following are among the most generally useful local measures, what is suitable for one case often having no effect upon another:

Hot water, tar, pure or in combination, yellow wash, chloral, camphor; or,

℞ Chloroform ..... 2 gm.
Adipis ..... 20 "
M.—Keep corked in a wide-mouthed bottle.

Or,

℞ Acid. hydrocyanic. dil. ..... 10 to 50 gm.
Glycerini ..... 15 gm.
Aquæ .....q. s. ad 100 "
M.—Ft. lotio.

Finally, electricity, either the induced or the continued current, has moderate curative power over some cases.

Pediculi Pubis.—These parasites may be found upon the scrotum, as they may, in fact, upon any part of the body from which the hairs of puberty grow. They exist in greatest abundance, however, about the genitals, and particularly on the mons veneris. They are plainly visible to the naked eye, as are their eggs attached to the hairs (Fig. 115).

FIG. 115.—PEDICULUS.
a. Nit attached to hair.

Mourson,[1] a French naval surgeon, first pointed out the relation between certain blue spots on the skin and pediculi pubis, and Douguet confirmed the relationship by inserting a bruised pediculus under the skin and producing a spot. Mallet proved that the coloring matter resides in the salivary glands of the pediculus.

No treatment is better than the old-fashioned blue mercurial ointment, which may be rubbed into the hairy parts about the pubes and perineum and somewhat down the thighs, the patient going to bed in drawers and sleeping covered with the ointment all night. Two such applications, at a few days' interval, usually destroys the colony. The treatment is a very dirty one, and much soap and hot water form essential parts of it.

INJURIES OF THE SCROTUM

Wounds.—Wounds of the scrotum, whether surgical or accidental, give rise to free bleeding. This must be entirely controlled by ligature before the wound is sutured, for in the lax scrotal tissues an insignificant oozing may give rise to an enormous hematoma extending to penis, thighs, and abdomen.

If the hemostasis is really efficient, the wound may be closed by a continuous suture with the points close together (since the dartos tends to separate the edges). As a further precaution, the scrotum may be compressed beneath the adhesive-plaster dressing described on p. 931.

Loss of Tissue.—When any considerable portion of the scrotum is destroyed by gangrene, accident, or the knife, the rapidity with which the defect covers in is little less than marvelous.

Castration need never be performed, however great the loss of integument. Kocher's [2] case, in which both testicles were practically covered

[1] *Lancet*, 1882, ii, 454.
[2] "Deutsche Chir.," 1887, l (b), 8.

over by skin in the short space of three weeks, shows what brilliant results may be obtained by expectant treatment. The surgeon need only help with tension sutures and aseptic dressings.

Hematoma and Hematocele.—Contusions of the scrotum give rise to extensive ecchymosis and edema quite comparable to the familiar black eye. If seen early the hemorrhage may be checked by adhesive-plaster compression and an ice-cap. Later heat promotes absorption, which is rapid. The hematoma need not be incised.

Scrotal or extravaginal hematocele (blood cyst of the scrotum) is a very rare result of scrotal hematoma.

INFLAMMATIONS OF THE SCROTUM

Inflammatory Edema.—Extensive edema may complicate any inflammatory affection of the scrotum on account of the laxity of its tissue and its dependent position. Scrotal edema may also be due to any obstruction to the return of its blood, as occasionally to the hard inflammatory induration about an inguinal adenitis, or it may occur in connection with general anasarca.

Where edema is excessive, and the tension so great that injury to the skin seems imminent from pressure, a few punctures may be made on each side of the raphe, at the most dependent point of the scrotum. These punctures should be protected by a wet dressing to encourage oozing, to improve the circulation, and to prevent infection. In milder cases, strapping (p. 621) will quickly reduce the edema, if the cause has been removed and a suspensory bandage is applied.

Cellulitis and Abscess.—Cellulitis and abscess of the scrotum are encountered clinically as phenomena in the development of urinary infiltration (p. 263).

Erysipelas.—The peculiar virulence of scrotal erysipelas is in striking contrast with the milder inflammations of this region. It is most frequently observed in the aged and debilitated, and may be spontaneous or due to trauma.

In the beginning, the rapidity of invasion and the superficial nature of the lesion distinguish it from urinary infiltration. In the later stages the two closely resemble each other.

Treatment.—Multiple free incisions parallel to the raphe, and the lavish use of 1-per-cent carbolic-acid wet dressings and hot baths daily should be employed. Tonics and stimulants may not be neglected.

Gangrene.—Gangrene of the scrotum, whether due to urinary infiltration, infection, or injury, usually involves the greater part of the scrotum, is accompanied by considerable constitutional disturbance, and often terminates fatally, especially in the aged and diabetic. The testicles are always spared and swing bare and bald. As already noted,

the skin of the scrotum heals with such marvelous rapidity that plastic operations are rarely necessary.

Treatment.—Stimulation, free incisions, wet dressings, and excision of sloughs as fast as they form are the main lines of treatment. Castration is never indicated.

Diphtheria.—Le Clerc [1] has observed and collected a number of cases resembling, clinically, an acute erysipelas, and which he attributes to diphtheria, the Klebs-Loeffler bacillus having been cultivated, either pure or in mixed culture, from the wound discharges.

Emphysema.—This occurs with general subcutaneous emphysema and with scrotal gangrene.

Scrotal Fistula and Calculi.—These are of urethral origin.

ELEPHANTIASIS, LYMPH SCROTUM, LYMPH VARIX

Elephantiasis is a condition of chronic distention of the lymph vessels of any part of the body, whereby the skin and subcutaneous tissues become thickened and indurated and the part often enlarges to an incredible size. It occurs usually in the lower extremity and in the penis and scrotum. With the last we are here interested.

Etiology.—The cause of elephantiasis is obstruction of the lymph channels. Thus I have seen scrotal elephantiasis following extirpation of the inguinal glands.[2] Severe chronic inguinal adenitis may have the same unhappy effect. But the enormous elephantiasis, so frequent in the tropics, is due almost always to the *filaria sanguinis hominis*. The fascinating life history of the filaria has been studied by Lewis,[3] Manson,[4] Le Dentu,[5] Mastin,[6] Lothrop and Pratt,[7] and many others. Born in some marsh or swamp, the embryo enters a man's alimentary canal in a sip of water. Thence it makes its way to the lymphatics, where it settles down for life and attains its full development. Here it is impregnated and pours into the blood current an infinite stream of embryos. By night the blood is alive with them, by day not one can be found where, a few hours before, were myriads: where they hide no one knows. But in the human host they cannot develop. To reach maturity they must be sucked up by a mosquito—a night-prowling insect. The mosquito, gorged with blood, returns to deposit her eggs and die in his (or rather her) native swamp, where from her corpse

[1] *Guyon's Annales*, 1898, xvi, 1102.

[2] Cf. *Bull. soc. française de dermat. et syph.*, 1898, ix, 292.

[3] "On a Hematozoön Inhabiting Human Blood," 1872, Calcutta.

[4] *Med. Times and Gazette*, 1875, ii, 542, 566; *Trans. Path. Soc.*, 1881, xxxii, 285; *Brit. Med. Jour.*, 1899, ii, 644.

[5] *Revue de chir.*, 1898, xviii, 1.

[6] *Ann. of Surg.*, 1888, viii, 321.

[7] *Am. Jour. of Med. Sciences*, 19, cxx, 525.

arise the filariæ ready to develop, to infest the water, and again to be swallowed by some unsuspecting man.[1]

So much for the romance. The sorry fact is that these embryos, no larger than a leukocyte, become impacted in the lymph glands or channels in such a way as slowly and progressively to obstruct the lymph flow. If this happens in the lower inguinal glands, elephantiasis of the lower extremity results; if in the upper chain, the scrotum and penis are affected; if in the iliac glands, *lymph varix* and *lymphadenoma* of the spermatic cord may result.

Chyluria (or hemato-chyluria) and *chylous hydrocele* are caused by rupture of a dilated lymphatic vessel into the cavity of the urinary tract or into the tunica vaginalis.

Symptoms.—Elephantiasis begins with recurring attacks of dermatitis and edema accompanied by fever. At first, there is between the attacks only a brawny patch upon the skin and a slight enlargement of the inguinal glands. As the disease progresses, the skin and subcutaneous tissues become thickened by an overgrowth of dense fibrous elastic tissue, and the vessels, especially the lymphatics, become enormously dilated. As the scrotum enlarges it drags down the skin of pubes and perineum and inverts the skin of the penis, leaving, finally, no trace of that organ, except a transverse slit on the anterior surface of the tumor. The tumor reaches incredible proportions. Wilkes removed a scrotum weighing 165 pounds, and Larrey mentions one weighing 200 pounds.

Treatment.—The *prophylaxis,* avoidance of unboiled drinking water in the tropics, need scarcely be insisted upon. *Curative* treatment is surgical. Fortunately, ablation of the hypertrophied tissues is rarely followed by recurrence, though such an operation does not pretend to affect the mother worm or her ovulation. The chief danger of operation is the bleeding. This was successfully controlled in an operation for vulvar elephantiasis, at which I had the pleasure of assisting, by Wyeth's hip pins and an Esmarch bandage.[2] It is essential to remove as much as possible of the indurated tissue, and yet to leave flaps to cover the testicles and penis. Radical cure of hernia may also be required. The strictest asepsis should be observed to avoid lymphatic absorption. In the smaller cases the inguinal glands may be removed.

TUMORS OF THE SCROTUM

Cysts.—Small sebaceous cysts, shining white through the distended skin, occur on any part of the scrotum, but particularly on the raphe.

[1] Of late years there is a tendency to consider the mosquito the adequate intermediate host, as is the case in malaria. I have sketched the classic theory, although it will perhaps be proved incorrect.

[2] Bullard, *Med. Record*, 1899, lv, 128.

They sometimes attain startling dimensions. Echinococcus cysts have been met with. A urinary pocket opening into the urethra behind a stricture has been mistaken for hydrocele. Jacobson [1] gives a detailed account of two cases of cystic disease of the scrotum, to which Tilden Brown [2] has added a third.

Multiple minute blood cysts, doubtless capillary dilatations, varying in size up to that of a large pinhead, and sprinkled abundantly over the entire scrotum, are sometimes found after middle life. They are of a dark-blue color and give rise to no changes in the skin and to no symptoms whatsoever, excepting their appearance, which annoys the patient. They may be cured permanently by touching each one separately with an electro-cautery, or pricking it and touching the raw surface with a nitrate-of-silver point.

Cases of *angioma, fibroma, lipoma, fibromyxoma, osteochondroma,* and *sarcoma* have been reported.

Epithelioma of the Scrotum (*Chimney-Sweeps' Cancer*).— Soot seems to be the exciting cause of scrotal epithelioma (Fig. 116) in England, although in other countries those whose occupation brings them into contact with this substance do not seem to suffer. Thus Warren [3] states that he has seen it a few times in this country, but never among chimney-sweeps.

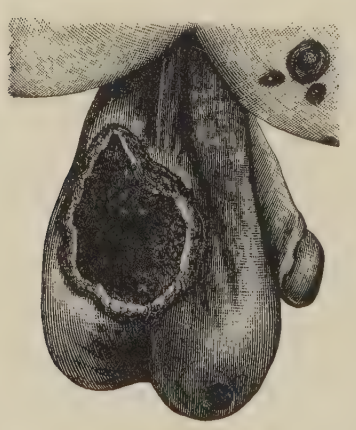

Fig. 116. — Epithelioma of the Scrotum in a Paraffin Worker. Three ulcers on the right buttock.

The disease begins as one or more small, soft warts or tubercles, usually at the lower forepart of the scrotum. These remain unchanged for a time, but finally indurate slightly, become excoriated, scab over, and ulcerate, the ulcer extending backward, and destroying, with more or less rapidity, the whole scrotum. Sometimes the testicles are involved, sometimes they escape. The ulcer is epitheliomatous. It has the hardened, irregular, purplish, everted, knotty borders; the hard, uneven, unhealthy looking base; the ichorous discharge, now sanguinolent, now purulent.

Death occurs by exhaustion, or by hemorrhage, if a large vessel be severed by the advancing ulceration. The disease continues local for some time. It is only tardily that the inguinal glands become involved.

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[1] *Op. cit.*, p. 565. [2] *Jour. of Cut. and Gen.-Urin. Diseases*, 1895, xiii, 33.
[3] "Surgical Observations on Tumors," p. 329.

Treatment.—Before the disease has assumed a malignant aspect it may be snipped or burned out. But when frankly cancerous an elliptical piece of the surrounding skin should be excised with the growth. If the testicle is involved, or if its integrity is doubtful, it had best be sacrificed. The inguinal glands, which enlarge late in the disease, should be treated according to the rules laid down for epithelioma of the penis (p. 702). The earlier the operation is undertaken the less the probability of relapse, though a second or third operation may succeed where the first has failed.

CHAPTER LVII

ANATOMY, PHYSIOLOGY, EMBRYOLOGY, AND ANOMALIES OF THE TESTICLE

ANATOMY

The testicles (Fig. 117), each suspended by its spermatic cord, lie loosely in the scrotum, surrounded by connective tissue. The left is usually slightly larger than the right and hangs lower. The mean dimensions of the testicle, according to Curling, are $1\frac{3}{4}$ inches long, $1\frac{1}{4}$ inches anteroposteriorly, and 1 inch laterally. Two of the envelopes of the cord, the cremaster muscle and the infundibuliform fascia, also cover the testicle, while the remains of the gubernaculum testis attach it to the bottom of the scrotum.

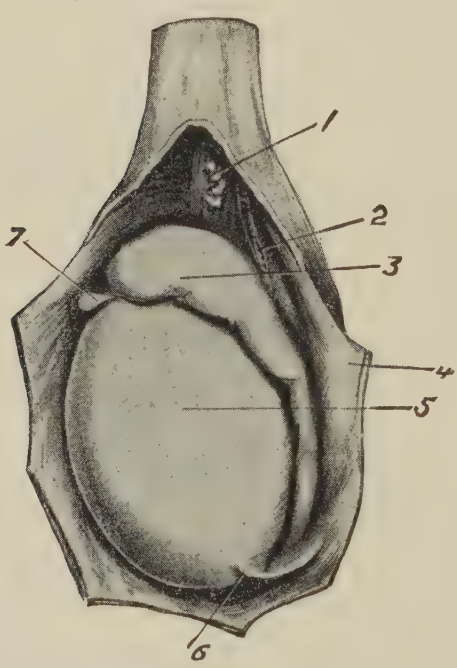

Fig. 117.—Left Tunica Vaginalis Opened, Showing Testis, Epididymis, etc., from Outer Side. 1, organ of Giraldès; 2, vas deferens; 3, globus major of epididymis; 4, 6, tunica vaginalis; 5, testicle; 7, hydatid of Morgagni (Quain).

Tunica Vaginalis.—The proper coverings of the testicles are two — the tunica vaginalis and the tunica albuginea. The former is a closed serous sac, investing all the secreting portion of the testicle, except where the epididymis is attached behind and the remains of the gubernaculum below. It dips down posteriorly, between the epididymis and the testicle. On the outer side the tunica vaginalis covers and closely invests the epididymis. The reflected layer forms a closed sac, and extends up the cord to a greater or less extent.

The tunica vaginalis represents a portion of the peritoneum carried

down by the testicle in its descent from the abdomen. Ordinarily, at birth, all connection between its cavity and that of the peritoneum is closed, a white, fibrous line (habenula) alone marking the original continuity of membrane. Sometimes, however, the opening persists, in which case congenital hernia is likely to occur; or the communication may be a narrow canal, open to the passage of fluid only; or again, partial obliteration may occur, isolated serous sacs being left along the cord; finally, it more often happens that the upper aperture is closed, and a considerable portion below remains unobliterated, so that the tunica vaginalis extends for some distance upward in front of the cord.

The cavity of the tunica vaginalis is lined by pavement epithelium, and normally contains only enough fluid to lubricate the surfaces.

Tunica Albuginea.—The tunica albuginea is the proper investing membrane of the secreting portion of the testicle. In its substance the branches of the spermatic artery ramify and break up, to be distributed to the seminal tubules within. It is composed of dense, white, fibrous tissue, is only slightly extensible (whence the pain in orchitis), and sends trabeculæ into the substance of the testicle to break it up into compartments (about 400 in each testicle) for the lodgment of the tubuli seminiferi. It forms the mediastinum (corpus Highmorianum) above and behind, where the vessels pass to and from the testicle, and where the straight tubes come out to form the coni vasculosi in the head of the epididymis.

Glandular Substance.—The glandular substance of the testicle consists of innumerable little tubes (tubuli seminiferi) closely packed in conical segments between the fine, fibrous septa thrown out by the tunica albuginea. The number of these cones is computed to be from 250 to about 500, and their combined length from 1,000 to 5,500 feet.

They consist of a membrana propria, within which are several layers of epithelial cells, the outer ones polyhedral, those nearer the lumen spherical. These latter are known as spermatoblasts, and from them the spermatozoa are evolved. Section through a tubule shows the stages of this process by which the cells become pear-shaped, tailed, and finally full-fledged spermatozoa.

Issuing from the apices of the cones the tubes unite to form 20 or 30 tubes (vasa recta), which run straight into the fibrous mediastinum, and there form an irregular plexus of channels with no proper walls (rete testis). Issuing hence the ducts, now known as vasa efferentia, pierce the tunica albuginea to form the epididymis.

The Epididymis.—The epididymis caps the testicle proper and skirts its posterior border. It begins above, where the vasa efferentia issue through the tunica albuginea. These canals immediately dilate and col-

lect in convoluted cones (coni vasculosi), forming the broadest part of the epididymis, the head or *globus major,* which lies over the top of the testicle. The coni vasculosi all empty into one canal—the canal of the epididymis, which forms by its convolutions the central part or body of the epididymis. This body is separated from the testicle proper by the *cul-de-sac* of the tunica vaginalis. Below, the canal of the epididymis exhibits further convolutions. At this point it is known as the *globus minor,* or the tail of the epididymis. Connective tissue unites it to the testicle to this point, and from here on the canal becomes more dense, and is known as the vas deferens.

The little supernumerary diverticulum (or there may be several), known as the *vas aberrans* of Haller, when present, usually empties into the canal of the epididymis at this point. The canal of the epididymis is furnished with ciliated epithelium whose cilia sweep toward the vas deferens.

There exist normally upon the head of the epididymis several little prominences, solid and cystic, known as the hydatid of Morgagni, or pediculated hydatid, the corpus innominatum of Giraldès, and the non-pediculated hydatids. They are the remains of the Wolffian body and of the duct of Müller.

The blood supply of the testicle and epididymis is derived from the spermatic artery. *The lymphatics* empty into the lumbar (not the inguinal) glands.

PHYSIOLOGY

External Secretion.—The function of the testicle is to form spermatozoa, the male procreative seed. These microörganisms are the result, not of a secretion, but of an evolution of the spermatoblasts of the seminal tubulus. Thence they issue by force of their own motility to the epididymis, where their transit is hastened by the ciliated epithelium. From the vas deferens they are collected in the seminal vesicle and ampulla, whence they are ejaculated during the sexual orgasm.

Internal Secretion.—The so-called internal secretion of the testicles—viz., the effect of the presence of the testicles upon the organism at large—has been studied anew of late years in connection with the discussion over the propriety of castration for hypertrophy of the prostate. It has long been known that the testicles are essential to a virile adolescence, since castration in infancy produces the recognized type of high-voiced, effeminate eunuchs. The familiar contrast between ox and bull, horse and stallion, is equally to the point.

This internal secretion is derived from cells lying in the stroma of the testicles, between the tubules.

EMBRYOLOGY[1]

The two constituent parts of the testicle, which have been briefly described above, are developed separately in the fetus. The epididymis is formed from the lower part of the Wolffian body, and its duct is a continuation of the Wolffian duct to the lower and back part of the bladder. The deferential artery, a branch of the hypogastric, supplies it. The secreting portion of the testicle, on the other hand, is formed from fetal tissue lying in front of, but seemingly independent of, the Wolffian body, and its artery, the spermatic, comes from the aorta just below the renal artery. This peculiarity of vascular supply may account for the fact that one part of the organ is often diseased, the other part remaining sound.

The Descent of the Testicle.—The testicle develops in front of the Wolffian body, resting upon the brim of the true pelvis near the site of the future inguinal canal, which at this period (fifth month) is represented by the *processus funiculo-vaginalis,* a pouch of peritoneum running into and terminating among the muscle fibers of the abdominal wall, through which it ultimately extends into the scrotum. This pouch offers a resting place into which the testis tends to work its way, aided by the *gubernaculum testis,* a fibro-muscular cord attached above to the testis, epididymis, and spermatic cord, below to the abdominal wall, the inner surface of the pubes, the bottom of the scrotum, the perineum, and by a few fibers to the thigh over the saphenous opening. Guided, or perhaps pulled—the point is disputed—by the gubernaculum, the testicle settles into the peritoneal pouch, and with it sinks gradually through the abdominal wall and into the scrotum. The stronger fibers of the gubernaculum, fastened to the bottom of the scrotum, persist in adult life as a fascial band, while the processus funiculo-vaginalis, inverted by the descent of the testis, becomes the tunica vaginalis. The part of the processus above the testis is obliterated by adhesion of its opposed surfaces, beginning at both ends, above at the internal abdominal ring, below quite near the testicle. When adhesion is complete only a fibrous cord, the *habenula,* remains.

The descent of the testicle into the scrotum occurs during the last six months of intra-uterine life.[2] Indeed, in 10 per cent or 20 per cent of all children the testicles are still in the abdomen at the time of birth. In most of these the testicle descends during the following weeks, but in a small proportion of cases it is retained for years, or even perma-

[1] Cf. Kocher, *op. cit.*, p. 547; Jacobson, *op. cit.*, p. 1; Curling, "Diseases of the Testis," 4th Ed., 1878, p. 14; Monod and Terrillon, "Traité d. mal. du testicule," 1889.

[2] Only mammals, and not all of them, have extra-abdominal testes, while some mammals retain the testes within the abdominal cavity, except during the rutting season, when they become congested and are extruded into the scrotum.

nently. The clinician need take no account of the position of the testicle during the first year, but if it is retained for longer than this the condition is definitely abnormal.

ANOMALIES OF THE TESTICLE

Monod and Terrillon's classification of anomalies of the testicle is the following:

Anomalies in development	In number	In excess		Polyorchism.
		Deficient	Absence	Anorchism.
			Fusion	Synorchism.
	In size	In excess		Hypertrophy.
		Deficient		Atrophy.
Anomalies in migration	Undescended	Incomplete migration		Retention.
		Abnormal migration		Ectopia.
	Descended			Inversion.

I. Anomalies of Development.—**Polyorchism.**—Though many instances of supernumerary testis have been reported, and the condition is known to exist in the lower animals (Jacobson), the alleged instances in man have proved to be pedunculated tumors, encysted hydrocele, omental hernia, or have lacked the proof of a pathological examination, with the exception of the case reported by Arbuthnot Lane,[1] in which the diagnosis was confirmed by a microscopical examination of the supernumerary organ.

Anorchism.—The testicle may be lacking on one or both sides. With absence of the testicle is associated:

1. Usually absence of the epididymis and part of the vas, or
2. Exceptionally, entire absence of the seminal duct up to the vesicle, or
3. Still more rarely, the testis only is wanting, while
4. The testis may be present and the vesicle, epididymis, and vas absent (Jacobson).

During life anorchism cannot be differentiated from abdominal cryptorchism, except by operation.

Synorchism.—Jacobson cites the cases of Cruveilhier and Lockwood, the one in an adult, the other in a fetus, of intra-abdominal testicular fusion.

II. Anomalies in Migration.—**Cryptorchism.** — *Cryptorchism* means absence of one or both testicles from the scrotum, and their presence elsewhere, in contradistinction to *anorchism*, mentioned above, meaning total absence. *Monorchism* is unilateral cryptorchism. A *retained testis* is one that has been arrested at some point in its normal descent. An *ectopic testis* is, strictly speaking, one that has lodged at

[1] *Brit. Med. Jour.*, 1894, ii, 1241.

some point out of its normal course. The term ectopia testis is often used loosely as a synonym for cryptorchism.

Cryptorchism is an infrequent anomaly. Marshal found 11 cases among 10,800 English recruits, of which only 1 was bilateral. Rennes met with only 6 cases among 3,600 French recruits; none bilateral.

Retention.—By obstruction to its progress or by traction from behind (peritoneal adhesions, shortness of the vas, etc.) the testis may be retained inside the abdomen, or it may be arrested at any point in its descent. Hence there may be: 1. *Abdominal retention,* the testis lying in the lumbar region, or floating attached by a "mesorchium," or resting in the false pelvis near the internal abdominal ring (iliac retention). 2. *Inguinal retention,* the most common variety, the testis lying at the internal abdominal ring (internal inguinal retention), in the canal (interstitial inguinal retention), or at the external ring (external inguinal retention). 3. *Pubo-scrotal retention,* the testis lying just under the pubic bone. 4. Rarely the testicle alone is retained, while the epididymis and vas are separated from it and descend normally into the scrotum.

Ectopia.—Abnormal tension of some of the accessory bands of the gubernaculum may drag the testis out of its normal course: (1) into the perineum, where it will lie beneath the deep fascia, in front of the anus; or (2) through the crural canal to the saphenous opening (very rare); or (3) into the opposite side of the scrotum (cases of Jordan [1] and von Lenhossek); or (4) to the front of the pubis at the base of the penis (2 cases of Popow's [2]).

Inversion.—The testicle may be turned upside down in the scrotum, or rotated so that its long axis is horizontal or abnormally attached to the epididymis (cf. Jacobson). The only clinical significance of these very rare anomalies is their bearing on puncture of hydrocele, for the inverted testis often lies above and in front of instead of below and behind the tunica vaginalis.

Condition of the Testicle.—The retained testis is almost always found postmortem in a state of fatty or fibrous degeneration. In some cases the testicle may never have reached even an incomplete development on account of some congenital fault; but, as a rule, the testicle is normal at first, and its atrophy is rapid or slow in proportion to the pressure to which it is subjected. If both testes are retained in the abdomen they may atrophy so early in life as to leave the individual eunuchoid, practically asexual in both his mental and physical character; but, happily, the glands usually retain their physiological capacity long enough to endow their host with masculine attributes and even potency. The sterility of cryptorchids has been hotly debated.

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[1] *Deutsch. med. Woch.*, 1895, xxi, 525. [2] *Bull. de la soc. anat.*, 1888, v, ii, 653.

It is true that a great majority of double cryptorchids are sterile, and so general is the application of this rule that Curling,[1] after citing several cases of women married to cryptorchids bearing one or several children, felt compelled to doubt the paternity. But several similar cases have been reported since, a notable one by Milner Smyth,[2] whose patient begot five children, and the question is seemingly closed by the observations of Beigel [3] and of Valette.[4] The former found numerous spermatozoa in the semen of a double cryptorchid aged twenty-two. The latter found a few in the retained testicle removed from a man twenty-one years old.

In determining the sterility of any given patient several points must be taken into consideration.

1. The position of the testicles, since abdominal cryptorchids appear to be always sterile.

2. Freedom from previous or present inflammation.

3. The size, consistence, sensitiveness, and motility of the testicles, and

4. The age of the patient. Bellingham Smith [5] observes that all the cryptorchids to whom children have been attributed were young men, and that, therefore, although cryptorchids may retain their virility until puberty, their period of possible paternity is not over five or ten years.

5. A definite conclusion is impossible, except from the microscopical examination of the semen for spermatozoa.

Complications of Cryptorchism.—*Neuralgia* of the testicle is an early evidence that the surrounding muscles are exerting injurious pressure upon the gland. *Inflammation,* whether traumatic, gonorrheal, or tubercular, is not rare, and, if acute, is exquisitely painful. *Atrophy* follows. Hydrocele, gangrene, abscess, and fatal peritonitis are among the rarer consequences of inflammation.

Malignant growths are frequent, especially sarcoma. The degenerated condition of the organ and the constant irritation to which it is subjected render it particularly liable to malignant changes. The frequency of these growths is the most weighty argument in favor of castration.

Hernia often accompanies inguinal retention, since the testicle keeps the canal patent. Absence of the testicle from the scrotum gives a clew to the differentiation between retained testis and hernia. When the testicle becomes strangulated by torsion of the cord it simulates strangulated hernia.

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[1] *Op. cit.*, p. 467.
[2] *Lancet*, 1899, ii, 785.
[3] *Virchow's Archiv*, 1867, xxxviii, 144.
[4] *Lyon méd.*, 1869, ii, 20.
[5] *Guy's Hospital Reports*, 896, liii, 215.

Prognosis.—Spontaneous descent of the testicle may not be looked for after the first year in any large proportion of cases. A sudden muscular effort caused spontaneous descent of the testicles of a man thirty-three years old (Landouzy), but this is a most exceptional case. Ambrose Paré has left an amusing account of one Marie Germain who jumped a ditch in chasing her pigs when, feeling a sharp pain and "seeing her genitals develop," "s'en retourne larmoyant en la maison de sa mère disant que ses tripes lui estoient sorties hors du ventre," whereupon her true sex was recognized and she became a man.

In general the prognosis of retained testis is "atrophy, perhaps sarcoma."

Treatment.—During infancy every effort should be made by pad and truss to encourage the testicle to descend. Success is possible up to the tenth year.

If mechanical treatment does not effect reduction, the testicle may be allowed to remain where it is, or operation may be performed to drag it down or to extirpate it. If there is pain or hernia, this attempt should certainly be made and the testicle sacrificed if it cannot be brought down. Broca [1] has succeeded in bringing down 138 such testicles without a death. Of 79 cases observed for over a year 31 had apparently normal testicles, 35 had testicles normal in quality, but abnormal in position (near the external ring), while in only 13 had the gland atrophied. In 1 case the abdominal wall remained weak, and in no case was there any recurrence of pain. Only once was castration required. The operation should not be attempted before the seventh year nor delayed beyond the tenth.

When this operation fails, castration is, in most instances, preferable to abdominal reposition, which subjects the gland to the very dangers (except hernia) to be avoided.

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[1] *Gaz. Hebdom.*, 1899, iv, 289, and *Gaz. des hôp.*, 1899, lxxii, 315.

CHAPTER LVIII

INFLAMMATIONS OF THE TESTICLE AND EPIDIDYMIS

Inflammation of the testicle may be limited to the epididymis (epididymitis), or may attack the secreting structure only (orchitis). Sometimes both parts inflame simultaneously—as after injury. The secreting structure may become secondarily involved by a simple inflammation commencing in the epididymis, but the latter rarely suffers in connection with primary, true orchitis. The tunica vaginalis, lying close to the epididymis, becomes inflamed in most cases of epididymitis, constituting acute hydrocele. On the other hand, hydrocele is rare with orchitis, since the dense tunica albuginea prevents an inflammation originating on one side of it from being readily transmitted to the other.

Etiology.—Inflammations of the testicle may arise by—

1. Infection passing along the seminal canals from the urethra.
2. Infection from the blood or the lymph.
3. Trauma.

1. To the first class belong simple inflammatory and gonorrheal infections; they involve the epididymis primarily, the testicle only secondarily.

2. To the second class belong tubercular and syphilitic inflammations (the former usually beginning in the epididymis, the latter in the testicle) and the orchitis of infectious diseases.

3. Inflammations of the third class (traumatic) implicate both testis and epididymis, but chiefly the former.

EPIDIDYMITIS

Epididymitis is the most common of all the diseases of the testicle. It occurs at any age, most frequently during early adult life and middle age, since its chief cause—urethral inflammation or irritation—exists most commonly during these periods of life. It has an acute form, but is very prone to run into the chronic state, and may be subacute from the first. It habitually terminates in resolution, rarely in abscess. One attack predisposes to another. It is often double, but the two testicles are very rarely simultaneously involved; the inflammation of one usu-

ally precedes that of the other by a number of days or weeks, after which the disease sometimes returns to the testicle first invaded, chiefly in badly managed cases.

Etiology

The prime cause of epididymitis is inflammation of the *posterior* urethra. The inflammation travels from the urethra up the ejaculatory duct and along the vas deferens, not by a microbic migration, but by an actual extension of the inflammation along the mucous membrane of these canals. This explanation has long been disputed, but three facts may be laid down to prove it:

1. No matter what the condition of the anterior urethra, epididymitis never occurs except from inflammation or trauma of the posterior urethra.

2. The prodromal symptoms usually point to inflammation of the vas before there is inflammation of the epididymis.

3. Vasotomy [1] has, in my experience, cured the most inveterate cases of relapsing epididymitis, in two cases even bringing an acute attack to an abrupt termination.

Nearly all the causes enumerated as capable of producing orchitis may also exceptionally give rise to epididymitis. Gout, trauma, cold, and prolonged sexual excitement may cause it, but urethral inflammation is by far the most active cause. The most common form of this irritation is gonorrheal urethritis, then stricture, finally, any prostatic inflammation; the passage of instruments, especially through a urethra already affected by chronic inflammation or stricture, but occasionally where no appreciable disease exists; the use of the lithotrite; perineal section; retention of a calculus in the prostatic urethra—in short, any inflammatory affection of the prostatic sinus around the orifices of the ejaculatory ducts. In general, it may be laid down that epididymitis is to be looked for mainly from the third to the eighth week of gonorrhea. A number of cases are on record in which it is alleged that epididymitis has preceded the gonorrheal outbreak (Fourneaux-Jordan, Sturgis, Stansbury, Castelnau, Vidal). In my opinion these are not true cases of new gonorrheal infection, but instances of relapsing gonorrhea, in which a prostate already damaged is kindled by sexual exercise into acute irritation, which first shows itself by producing swelled testicle, and only later manifests itself as a discharge at the urethral orifice.

Some individuals seem predisposed to epididymitis, so that, notwithstanding the utmost care, every attack of gonorrhea is invariably attended by swelled testicles; while others, regardless of all hygienic

[1] Cf. Chetwood, *Jour. of Cut. and Gen.-Urin. Diseases*, 1900, xviii, 445.

precautions, go about with a raging gonorrhea, employing no treatment, continuing sexual intercourse and the abuse of alcohol, not even supporting the testicles, and yet they escape. Indeed, the one patient who took more scrupulous care of himself than any other in my whole experience, who went to bed and stayed there, took no local treatment whatever, and lived on the lightest of diets, in due time developed a double epididymitis, which terminated in suppuration on both sides.

It may, however, be stated dogmatically that while a gonorrhea of itself will sometimes, in spite of all precautions, occasion swelled testicle, yet this complication is not likely to ensue if the patient wear a suspensory bandage, abstain from violent or jolting exercise (horseback riding, dancing), and avoid bodily fatigue and efforts at lifting. Above all, sexual excitement or indulgence, and the use of alcohol in any shape, must be interdicted. The passage of instruments through a canal subject at the time to gonorrhea is a sufficient cause for epididymitis. The local, and especially the abortive, methods of treatment are, therefore, peculiarly liable to occasion swelled testicle. Yet, from an experience extending over several years, I am convinced that the modern, moderate local treatment, if promptly applied and properly administered, is the one way to prevent posterior urethritis, epididymitis, and all the other complications of gonorrhea.

The epididymitis of stricture and of prostatic hypertrophy is usually induced by instrumentation.

Any pyogenic bacterium may cause epididymitis. In operating upon the gonorrheal epididymis the gonococcus is usually found in pure culture.

Pathology

The inflammatory process is most acute at one or the other end of the *epididymis,* usually the globus minor. The duct is thickened by the inflammation and dilated in places by the accumulated secretions, desquamated epithelium, and pus. The connective tissue is infiltrated and edematous. Actual abscess formation is the rule, though the abscess is usually small, and after resolution of the inflammation the pus is absorbed. The round lump that remains is the seat of the abscess.

The testicle is congested, very rarely invaded by the abscess.

The tunica vaginalis is always inflamed and usually the seat of hydrocele, though this commonly disappears as the epididymitis subsides.

The seminal vesicle is always inflamed.

The vas suffers only a slight catarrhal inflammation. Periderferentitis, abscess, and peritonitis have been noted, but these are to the last degree exceptional.

As the inflammation declines, the associated lesions clear up and the edema is absorbed, leaving only one or more hard lumps in the epididy-

mis to mark the seat of abscess. In these lumps the epididymal canal is permanently damaged; dilated and catarrhal in some places, occluded in others. Occlusion of the epididymis is not the constant result of inflammation, but when it does occur is probably permanent. Hence, spermatozoa can never again issue from that testicle, and if both testicles are involved the patient is sterile. But the testicle does not atrophy on this account, nor is the patient's potency or sexual appetite at all impaired.

Symptoms

Epididymitis may come on in an acute or a subacute form, the latter usually when the epididymis has previously suffered from a similar attack. First attacks, like first attacks of gonorrhea, are usually the most severe. Epididymitis is ushered in by premonitory symptoms which precede the swelling by some hours. Usually the gonorrheal or gleety discharge is not visibly modified until after the testicle begins to swell. Then it diminishes, perhaps stops, to return again as soon as the inflammation of the epididymis is fairly on the decline.

Prodromes.—A vague uneasiness is felt in the testicle and along the cord up into the back, as if the cord were being pulled upon. Attentive patients will frequently aver that the pain was noticeable in the groin for some hours before any uneasiness was experienced in the testicle. There is usually only a slight painful tension in the groin, but sometimes it is very severe, extending around to the lumbar region and up the back. Sometimes there is a sense of weight in the perineum and frequent desire to urinate, with pain and difficulty in the act. Occasionally a chill ushers in the affection.

Onset.—1. Whether any of the foregoing symptoms have attracted attention or not, the attack begins with pain in the testicle, attended by swelling. The amount of pain and swelling varies in different cases. In the *subacute* form, the swelling is moderate, comes on rather slowly, and is confined to the epididymis. There is but little, if any, fluid in the tunica vaginalis. With such mild cases there are no constitutional symptoms and the pain is not excruciating. It is aggravated by the erect posture, but wholly disappears when the patient is put on his back with the testicle elevated.

2. But the picture is a different one if the onset is *acute*. The swelling commences promptly and increases with rapidity. First it is localized posteriorly, but soon it spreads to the tunica vaginalis and about the testis. The scrotal tissues become edematous. Yet, even under all these disadvantageous surroundings, with an edematous scrotum and a tensely filled tunica vaginalis, careful examination will rarely fail to localize the hardness and most of the pain in the epididymis. The inflamed mass rapidly reaches the size of the fist. The cord becomes

swollen and painful on pressure. Occasionally the cord becomes partly strangulated in the inguinal canal, since it is impossible for it to swell much there, surrounded as it is by firm fibrous structures. This gives rise to intense pain in the groin.

Pain.—Pain in acute epididymitis is great, increasing from the first proportionally to the swelling. The pain, however, is not so severe as in true orchitis. It is dragging, aching, and sickening, making the patient feel faint. Locomotion is almost impossible, the motions of the patient are very deliberate as he changes his position, and, if obliged to stand, he carefully supports and shields the swollen scrotum with his hand. While rest on the back with the testicle raised modifies, it does not allay, the pain, but in this position the torture is more bearable. If strangulation of the cord at the ring occurs, the pain is greatly intensified.

Course.—As the disease advances, pain increases in intensity for a day or two, remains stationary for several days after the organ has reached its full size, and finally begins to decrease, and, even in desperate cases, by the end of the second week has usually disappeared, or become reduced to the slight dragging uneasiness which constitutes the only pain of mild cases. This relief from pain is often experienced while the organ is yet large, the epididymis thickened, the scrotum edematous and some fluid still left in the tunica vaginalis.

The constitutional symptoms—fever, loss of appetite, etc.—like the pain, vary with the intensity of the inflammation. What fever there is disappears before the pain, and long before the swelling.

The gradual disappearance of the hardness from the epididymis may extend over many years, and in most cases is never entirely accomplished. The point first attacked is the last to resolve. The absorption starts rapidly, but progresses more and more slowly, until it seems to remain stationary. The little hard lump in the epididymis occasions the patient no uneasiness, is not sensitive to pressure, and is ignored.

Extensive *suppuration* is rare in gonorrheal epididymitis, but not uncommon in severe cases due to other bacteria.

Atrophy of the testicle never results.

Chronic or Relapsing Epididymitis.—Epididymitis may be said to have a natural limit of about two weeks for its acute symptoms, but relapses are very common, and carelessness may prolong the trouble to as many months. Relapses are habitually milder than first attacks. But the epididymitis that begins most mildly may go on by successive outbursts to become most severe.

Diagnosis

Nothing is easier than the diagnosis of an acute epididymitis occurring during a gonorrhea or provoked by urthral instrumentation. But

chronic or subacute cases may be mistaken for tuberculosis. (See Diagnostic Table, p. 635.)

Acute orchitis is distinguished by its etiology, the more marked general symptoms, and the fact that the testis proper, and not the epididymis, is chiefly involved.

Prognosis

The prognosis may be summed up thus: there is no danger to life, to sexual potency, or to desire. Neuralgia or tuberculosis may follow acute epididymitis in subjects predisposed to these ills. Sterility (of the affected organ) and relapse are both possible results, but, contradictory as it may seem, the more liable the patient to relapses, the less likely is he to be sterile. This does not mean that the greater the number of attacks the less damage done. On the contrary, each attack doubtless leaves its mark and may obstruct an epididymis which previous attacks have left patent. Yet this very patency of the canal constitutes at once a liability to reinfection and an assurance of fertility; whence the apparent contradiction has evolved itself that persons who have had but one attack of epididymitis in both testicles are less likely to be fertile than those who have had several.

Yet the patient is not impotent, his sexual power and appetite are unimpaired. He ejaculates semen resembling the healthy fluid in quantity, smell, and color, but containing no spermatozoa.

Benzler's [1] investigations are interesting in this regard. By looking up the subsequent history of old soldiers who had had gonorrhea while in the German army, he found that among those who had been married three or more years, 10.5 per cent of those who had suffered gonorrhea without epididymitis were childless, against 23.4 per cent of those who had had single epididymitis and 41.7 per cent of those who had had both organs inflamed.

On the other hand, traumatic epididymitis is far less likely than urethral epididymitis to lead to sterility, since the traumatic inflammation concerns the testicle and the surrounding tissue rather than the lumen of the canals. Thus Liégeois (Jacobson) found spermatozoa in the semen of only 7 out of 28 patients who had had double epididymitis, and of these, 5 cases were due to "local causes." Orchitis does not cause sterility unless the testicles atrophy.

Treatment of Epididymitis

Prophylaxis.—The prevention of epididymitis during the treatment of an inflamed urethra is compassed by means of gentleness. It

[1] *Archiv f. Derm. u. Syph.*, 1898, xlv, 33.

is impossible to lay down a fixed rule by which this complication may always be avoided. Even the rough passage of sounds through an inflamed urethra does not always cause it, while it may be excited by the gentlest of injections.

It is evident that inflammation invades the epididymis when an acute focus in the prostate or vesicle is lighted up by the trauma of urethral treatment. Yet the presence of this acute focus cannot always be ascertained, and, inasmuch as the complication sometimes arises when no urethral treatment is being employed, one cannot but feel a certain fatality in the matter. All that can be done is to exercise the greatest possible gentleness, especially in the introduction of dilating and metal instruments.

During acute gonorrhea it is customary to instruct the patient to wear a suspensory bandage, and this measure certainly reduces the danger of epididymitis, thought it does not entirely prevent it. When in the course of urethral inflammation complaint is made of a dragging, uneasy sensation in the groin or testicle, the patient should be placed immediately upon his back, the testicle elevated, and applications of cold or heat made in order to ward off the threatened attack.

Treatment of Gonorrheal Epididymitis.—The treatment consists of rest in bed, elevation of the testicle, applications to the testicle, and general medication.

Rest in Bed.—Although the mildest cases do not always require rest, one can never be sure when the first symptom of epididymitis appears whether the case will remain mild or whether, starting mildly, it will not go on by progressive extension to a prolonged or acute inflammation. Whenever this is possible, rest in bed is therefore required.

Elevation of the Testicle.—If the patient is in bed, the best way to elevate the testicle is by means of a broad strip of adhesive plaster passed across the thighs, and upon which the testicles rest. Previous to applying this strip the thighs should be shaved and the central portion of the strip should be protected by means of a flap of adhesive plaster or a pad of gauze, so that it shall not adhere to the perineum.

If the patient is about, the testicle may simply be supported by a suspensory bandage or jock strap, though much better elevation may be obtained by the use of Curling's bandage. This consists of a square piece of cloth folded in a triangle, the base of which should be about 30 cm. long. To the center of this base is tied the middle of a piece of tape about 1 m. long. The base of the triangle is then placed under the scrotum, one acute angle carried up on each side in the groin and tied to a waistband. The ends of the tape are then carried back around the folds of the nates like the straps of a suspensory bandage, and attached to the waistband in such a manner as to hold the center of the triangular cloth firmly in the perineum. The scrotum is then steadied by pinning

the loose folds of the triangular cloth over the front of it and to the waistband, care being taken not to make the central suspension so tight that the testicles slip to one side or the other out of the grasp of the bandage.

A less efficient but less complicated support may be constructed by using a waistband and a towel as a " T " bandage.

Applications to the Testicle.—Innumerable applications have been devised for the relief of acute epididymitis. The old-fashioned tobacco poultice is no longer used. For a number of years it was my custom always to paint the scrotum with a 50-per-cent mixture of guaiacol and glycerin, if the case was seen within twenty-four hours of its onset. But of late I have ceased employing this measure.

In most instances the best application during the acute stages is a flaxseed or a flaxseed and slippery-elm poultice, which should be renewed every two hours. The virtue of this application consists in its lightness and its great heat. The same amount of heat cannot be obtained in any other way except by the electric poultice. This is more convenient, but somewhat heavier. Hot-water bags are difficult to manage on account of their weight, and they require changing almost as often as the poultices.

Some patients prefer cold to heat, and for them the ice pack is the best application, though, as a rule, it is inferior to the poultice. Both cold and heat should be tried and the one employed which is most grateful to the patient.

As the acute stage subsides, a certain amount of heat may be retained by the use of antiphlogistin, but far preferable to this in hastening absorption is the application of a 20-per-cent ichthyol ointment. Saturated solution of Epsom salts has been suggested as a local application, but I have not found it peculiarly efficacious.

General Treatment.—Apart from the obvious light diet and attention to the bowels, general treatment should consist in attacking the infection directly by means of vaccines and dilating the vessels by means of vasodilators.

If the inflammation is a gonorrheal one, 50,000,000 to 100,000,000 bacteria should be injected when the case is first seen, and this injection repeated every other day at the higher dose until it is evident either that the vaccines are inefficient or that the inflammation is subsiding. Dr. Swinburne has obtained excellent results by the use of antigonococcus serum (2 c.c. q. d.). If the inflammation is not gonorrheal, autogenous vaccines may be employed, though we have no data as to their reliability.

Dilatation of the blood-vessels by means of the administration of one or two minims of tincture of aconite every hour is sometimes marvelously efficacious in relieving pain. This should always be em-

ployed during the acute stages, with due respect for the possibility of poisoning.

Operative Treatment.—The observations of Hagner have stimulated interest in the operative treatment of acute gonorrheal epididymitis.

Although gross suppuration is rare, a minute focus of suppuration is almost always present, and the relief of the tension in this focus, achieved by incision, promptly relieves all pain. Relapse after operation is extremely rare—probably not more than 2 per cent or 3 per cent.

But, apart from the sentimental objection to operation, the advantage of incision should not be overrated. If the case is not oversevere, incision does not promise to shorten its course, for the patient must lie

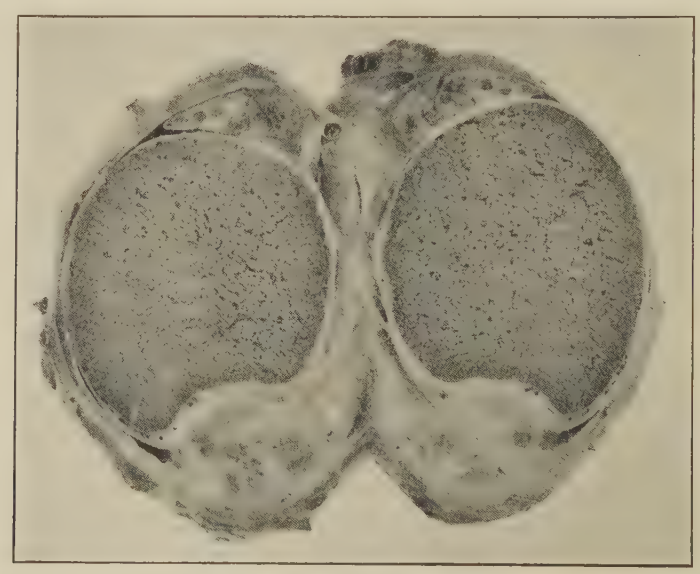

FIG. 118.—ABSCESS IN TAIL OF EPIDIDYMIS: RELAPSING EPIDIDYMITIS.

in bed for five to seven days after the operation, and this time would usually be sufficient to complete the cure; but if the inflammation is intense, if it tends to relapse progressively and to grow steadily worse, operation can be depended upon to check the inflammation and to result in a relatively rapid cure.

In nongonorrheal cases, if at all acute or obstinate, incision is especially indicated, for such cases may terminate in extensive suppuration, which can only be averted by prompt incision. If a large abscess has already formed, Hagner's technic may be disregarded and the abscess opened by a simple stroke of the bistoury.

Treatment of the Declining Stage.—The patient should be kept in bed until his temperature has been normal for forty-eight hours, and should be kept under close observation for forty-eight hours more

lest relapse occur. Thereafter, he may be permitted to go about, wearing a suspensory bandage, and in most instances no further care is required. In order to hasten absorption of the induration, strapping may be employed.

Strapping.—The strapping should be done so as to produce the maximum of pressure with the minimum of discomfort, and at no time should the testicle, which remains tender, be squeezed tightly enough to produce any lasting uneasiness. The method of strapping the testicle which I now employ is far superior to the old way with overlying strips of adhesive plaster. It was devised by Dr. Chetwood.

A piece of tape is first tied rather snugly about the base of the scrotum to hold the inflamed testicle down and its fellow up out of the way. A strip of light rubber (Martin) bandage, 15 or 20 cm. long and 10 cm. wide, and a piece of adhesive plaster, 1 cm. wide and 10 cm. long, constitute the apparatus.

Fig. 119.—Rubber Bandage for Strapping.

The adhesive plaster is stuck to one end of the bandage as shown in Fig. 119. The scrotum is gently lifted and the uninflamed testicle pushed up out of the way. The inflamed organ is then encircled with the rubber bandage as tightly as the patient can bear it (this is a matter of experience), and as the bandage is wrapped in place the adhesive plaster is brought around, and holds it fast (Fig. 120). Absolutely the only precaution necessary is to get the line of greatest pressure above the line of greatest swelling—i. e., to make the adhesive plaster encircle the organ above its equator, for otherwise it will promptly slip off. The advantages of this bandage need not be enumerated, but the chief one is that it may be removed daily to be put on more tightly. This it is expedient to do.

Fig. 120.—The Bandage Applied.

The Urethra.—Last, but not least, *no local treatment to the urethra* should be attempted during or after an attack of epididymitis. It will only harm the testicle without helping the canal. The length of time that must elapse before the urethra is again treated locally differs with every case. For most patients two weeks suffice; others can never again take an instrument without more or less risk.

Recurrent Epididymitis.—Each attack of recurrent epididymitis may be treated by the measures detailed above; but between times preventive measures must be instituted to ward off future attacks. This prophylactic treatment may be directed toward the general health, the posterior urethra, and the testicle itself.

A strict hygiene, sexual and general, is essential in every case. Aided by tonics, milk, fats, etc. (with perhaps a vacation), this alone may effect a cure.

The treatment of the posterior urethra depends upon its tolerance. If it will bear instrumentation, instillations, irrigations, and prostatic massage may well help; but in a certain proportion of cases such attempts only serve to stir up the testicle and make the patient worse. The hot rectal douche is here peculiarly applicable, since it is absolutely harmless.

The testicle itself should always be supported. I have known a man who could not for three months leave off a towel T-bandage which slung his testicles over his abdomen. No lesser support would prevent a recurrence of the attacks. Yet he is now permanently well. This case sufficiently exemplifies the principle involved.

If all these palliative measures fail, there is but one alternative. The patient must either get along with his testicle as well as he may, or submit to vasotomy. I hesitate to advocate this operation because it sacrifices the virility of a testicle which, from the very fact that recurrence of inflammation is possible, is probably able to produce spermatozoa. But, on the other hand, in every case put to the test, the effect has been immediate, absolute, and permanent. Not one died, not one relapsed, not one but was intensely gratified with the operation. I have watched one case for four years, others for a less time. This, at least, can be said of it: that the operation itself is quite insignificant, and that, like epididymitis, it never causes impotence, loss of desire, or atrophy of the testicle.

It is scarcely necessary to add the warning that active suppuration in the epididymis is uninfluenced by vasotomy.

ORCHITIS

Secondary orchitis—orchitis complicating epididymitis—is very rare. Primary orchitis—orchitis due to traumatism or to systemic dis-

ease—is also rare. Exceptionally orchitis occurs without discoverable cause.

Varieties

Several types of orchitis may be distinguished:

1. Traumatic orchitis. Testis and epididymis are both involved, and the malady runs a course quite comparable to that of acute epididymitis.

2. A low grade of orchitis, little more than a neuralgia. This attacks gouty or rheumatic individuals, and may be caused by a slight strain or by sexual excess.

3. Orchitis due to acute inflammations elsewhere. We are chiefly concerned with this form of the disease. It is a common complication of mumps, and has occasionally been met with during typhoid fever,[1] influenza, small-pox, tonsillitis, and rheumatism.[2] The orchitis of mumps is a type of all these.

Traumatic Orchitis.—Severe contusion, commonly a kick or a blow inflicted by a missile, causes an acute inflammation of the testis and epididymis, which, though usually short-lived, may terminate in atrophy of the testis, abscess, or gangrene. Lesser bruises or strains cause an inflammation which habitually terminates in resolution only. Yet atrophy may follow a slight injury.[3]

Orchitis from strain has been attributed to spasm of the cremaster and to compression of the cord by the abdominal muscles (Velpeau). It may perhaps be due to slight torsion.

Orchitis of Mumps.—The orchitis of mumps is most frequent at about puberty. It is almost unknown in childhood. It comes on near the end of the first week of mumps, and is usually confined to a single testicle. The testicle may, however, become inflamed before the parotid, and the mumps may even be confined to the testicle. Orchitis occurs in at least 5 per cent of cases of mumps in young adults. Indeed, Laveran [4] met with 156 cases of orchitis among 432 cases of mumps occurring in soldiers. The epididymis may or may not be involved. The affection runs a quick course of about a week or ten days, very rarely terminates in suppuration, may subside without leaving behind any impairment of the organ, but is often followed by atrophy. Thus atrophy occurred in 73 of Laveran's cases. Abscess and gangrene are very rare terminations. This form of orchitis has been fancifully termed metastatic. It is, however, nothing more than an expression of the disease. The inflammation of the testicle is no more metastatic than is the inflammation of the parotid.

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[1] Cf. Kinnicutt, *Med. Record*, 1901, lix, 801. [2] *Guyon's Annales*, 1894, xii, 306.
[3] *Ibid.*, 1885, iii, 230. [4] *Med. Times and Gazette*, vi, July 20, 1878.

Symptoms

Local Symptoms.—In true orchitis the testis increases slowly in size, and seldom becomes very large until the affection has lasted several days. This is due to the unyielding nature of the albuginea, and to the fact that there is usually no effusion into the tunica vaginalis. The pain, which is often excruciating, and always out of proportion to the amount of swelling, is due to the tension of the albuginea. This pain has been compared to that of nephritic or hepatic colic. No position gives rest, and any handling of the organ may induce syncope. The irritated cremaster contracts upon the sensitive testis and draws it up toward the groin. The pain continues severe for several days, and then gradually becomes more bearable, or it may suddenly cease altogether. This last circumstance is gratifying to the patient only. The surgeon learns it with regret, for he knows that it may mean gangrene of the organ.

The shape of the testicle is rarely altered in orchitis; it is smoothly, regularly ovoid. The epididymis is not distinguishable from the rest of the tumor. The organ feels peculiarly indurated, the natural elastic feel having entirely disappeared. The scrotal tissues are often red, swollen, edematous, inflamed.

General Symptoms.—*The general symptoms* in true orchitis are marked, often severe; chills, high fever, anorexia, nausea, vomiting, hiccough, constipation, sleeplessness, anxiety, and great nervous irritation. These symptoms have been compared to those of strangulated hernia, and, indeed, there is more or less strangulation of the testicle within its tight, fibrous sheath.

Termination.—The disease usually terminates by resolution. The testicle may then remain normal or it may go on to *atrophy,* this process requiring several weeks, at the end of which time nothing is left of the testicle but a small, insensitive mass.

Abscess is a rare termination and gangrene still more rare. The former is often announced by the occurrence of a chill. After the chill the testicle commences to enlarge more rapidly, the scrotal tissues adhere to its surface, and, after a longer or shorter period, the abscess bursts.

After the pus has escaped, the severity of the symptoms abates, unless a second purulent collection exists in some other part of the gland. As the flow of pus gradually decreases the swelling subsides and partial or total atrophy of the testicle ensues. The resulting fistula may remain open for years. Sometimes exuberant granulations grow up out of the opening, forming a cauliflower-like excrescence (hernia testis), which may reach a considerable size. Such a tumor growing from an enlarged, hardened testicle and accompanied by enlarged glands in the groin may well give rise to a suspicion of cancer.

Sometimes in true orchitis an abscess forms centrally, and never comes to the surface. In such a case the symptoms run a despairingly slow course, but the hard and tender organ gradually diminishes in size, while the purulent collection gradually becomes encapsulated. These testicles long remain the seat of chronic pain, and are liable to repeated outbreaks of inflammation.

The onset of *gangrene* is announced by a sudden cessation of the pain. Then, after adhesion to the scrotum, the slough makes its way through the skin, and is found not black, or brown, or fetid, but yellowish, dry, and soft.

Treatment

Treatment.—It is stated that the orchitis of mumps does not occur if the patient is kept in bed for eight days. Such a precaution is therefore a wise one for all young adults, though they cannot always be made to comply with it. The testicles should also be kept supported.

After the attack has once begun but little can be done beyond ameliorating the symptoms and endeavoring to prevent abscess or gangrene. The subsequent atrophy cannot be averted. The patient needs no urging to keep him in bed. Isham [1] refers to several reported cases which did well under jaborandi. Ice or poultices may be employed to relieve pain. Early employment of these means gives the testicle its best chance. If, in spite of them, the symptoms fail to abate, on the slightest suspicion of impending gangrene, or in any case where the symptoms run very high, it is wise to resort without delay to subcutaneous section of the tunica albuginea in order to take off tension from the strangulated parts within. This simple operation is readily performed with a sharp tenotomy knife introduced through the skin, and then made to cut the tense fibrous capsule, while the testicle is steadied in the other hand. The incisions should be carried fairly through the tunica albuginea, three to six short cuts 5 to 10 cm. long being made at different points on the surface of the testicle. The pain will usually cease after the tension has been relieved. If abscess form, puncture should be made on the first appearance of fluctuation. For gangrene castration should be performed.

Fistulæ are treated *secundum artem;* drained, irrigated, and cupped. A thoroughly disorganized fistulous testicle had best be removed.

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[1] *Am. Jour. of Med. Sci.*, 1878, lxxvi, 369.

CHAPTER LIX

DISEASES OF THE TESTICLE

LUXATION OF THE TESTICLE

P. Brüns [1] records the case of a man run over while lying on his back. The right testicle was dislocated over the pubis at the root of the penis. It remained there and did not atrophy. He refers to other traumatic dislocations, one under the skin of the thigh and a number into the inguinal canal.

HYPERTROPHY AND ATROPHY

The testicle undergoes compensatory *hypertrophy* when its fellow is defective or wanting, and in certain lusty individuals the testicles are abnormally large.

Arrest of development is typical in the retained testis and may also affect the normally situated organ for no assignable cause.

True *atrophy* is caused by severe orchitis in any form, by pressure (hydrocele, elephantiasis), by section or obstruction of the spermatic artery, by contusion of the testicle, by severe varicocele, and by injuries to the nerves, spinal cord, and brain. It may occur spontaneously or during the course of a syphilis without gummy deposit; but it is never caused by the internal use of iodids, by injury to the vas deferens (unless the vessels are injured), or by continence. Sexual excess is alleged to have caused atrophy of the testicles. The physiological atrophy of old age has been studied by Desnos,[2] Griffith,[3] and Pawloff.[4]

There are two forms of atrophy, the one *sclerotic,* the result of inflammation, the other *fatty,* the result of an obstruction to the circulation.

The orchitis of mumps is the most frequent cause of atrophy of the testicle.

Treatment.—For atrophy of the testicle nothing can be done.

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[1] *Mittheilungen aus der chir. Klinik zu Tübingen,* 1884, iii, 483.
[2] *Guyon's Annales,* 1886, iv, 72.
[3] *Jour. of Anat. and Phys.,* 1893–94, xxviii, 209.
[4] *Guyon's Annales,* 1894, xii, 291.

CONTUSIONS OF THE TESTICLE

Contusion of the testicle is rare, notwithstanding its exposed position. In severe contusions there is ecchymosis, and perhaps hematocele or orchitis; atrophy may result. One of the modes formerly adopted in the East for emasculating the attendants of the harem was that of squeezing the testis, and animals have been treated in this way in England and France (Curling). The inflammation after injury may be sufficiently severe to result in abscess or gangrene.

Kocher records 2 deaths from the shock of contusion of the testicle.

Treatment.—If the contusion be severe, the patient must be placed at once upon his back, with the testicle elevated and covered with an ice-cap; if subsequent inflammation occur, it must be met appropriately (p. 623).

WOUNDS OF THE TESTICLE

Punctured wounds, if small, are of no importance. They give rise to no inconvenience and heal kindly. Penetrating wounds of fair size, however, permit some of the tubular structure of the testis to escape. This is likely to be mistaken for a slough, and to be pulled out as such. Malgaigne mentions a case where the whole pulp of the organ was pulled out in this way. Injuries to the testicle, whether contusions or wounds, are exquisitely painful, and give rise to faintness, nausea, vomiting, and even convulsions. The testis may atrophy as the result of the injury or of a subsequent orchitis.

Treatment.—Hernia of the secreting substance should be reduced if possible, and retained by pressure, or by a suture through the tunica albuginea. If it cannot be reduced, it may be snipped off with the scissors, but should in no case be pulled upon. Large incisions should be cleaned, united by suture, and the parts carefully supported. Even if a large portion of the testicle has been destroyed by the accident, an effort should be made to preserve what is left. Dorsal decubitus must be maintained, and the testicle properly supported.

GANGRENE OF THE TESTICLE

Torsion of the Spermatic Cord.—Gangrene of the testicle is commonly due to this cause. Scudder [1] has collected 31 cases, to which he adds 1 of his own. Of the 32 cases, 17 occurred on the right side, 11 on the left. Seventy-five per cent of the cases occurred in patients under twenty-three, at an age, namely, when the individual is most exposed to

[1] *Annals of Surgery*, 1901, xxxiv, 234.

traumatism, and yet the trouble was usually attributed to nothing more violent than hard work or some indefinite strain. Indeed, in several cases the attacks were recurrent; thus, Van der Poel's patient learned that untwisting the testicle relieved the pain.

Etiology.—The only evident predisposing cause is malposition of the testicle. Ten times the affected gland was retained in the inguinal canal, 5 times close under the pubes. Hence, Scudder infers that a long mesorchium is required to permit torsion of the testis.

Pathology.—The pathological changes in the testicle are well known from the results of castration. The testicle is found congested, hemorrhagic, edematous, or gangrenous. There is usually vaginal hydrocele or hematocele. The cord is found twisted upon itself (outward in 7 cases, inward in 5) one half to two and one half turns, and strangulated at the point of torsion.

Symptoms.—The symptoms are those of strangulated hernia, for which it is commonly mistaken. The groin and scrotum swell rapidly and become exquisitely sensitive. The patient vomits and is feverish and faint. Chill and syncope may occur. If the testicle is normally situated it may unroll spontaneously, thus relieving all the symptoms; but with the testis in the inguinal canal this could scarcely happen.

It is probable that certain cases of acute spontaneous orchitis are due to slight or temporary torsion of the cord.

Diagnosis.—Torsion of the cord has been distinguished from strangulated hernia by the mildness of the systemic disturbance, after the first shock has passed, in contrast with the severity of the local symptoms. In case of doubt immediate operation solves the difficulty.

Treatment.—Recurrent torsion might be prevented by anchoring the testicle to the dartos.

In the emergency of an acute attack it may be possible to untwist the testicle, as was done by Nash an hour and a half after the onset of symptoms. (The testicle subsequently atrophied.) In the majority of cases, however, operation affords the only hope of relief. The operation has been performed 29 times with no deaths. Once the testicle was allowed to slough away through a simple incision. The cord was untwisted 5 times. This was followed twice by sloughing and thrice by atrophy. Twenty-three castrations were successful.

Injury to the Spermatic Cord.—While such injuries to the spermatic cord as totally shut off the blood supply of the testicle are calculated to cause gangrene of the organ, the impunity with which the cord may be tied off is exemplified by numerous cases collected by Mauclaire. This operation is, apparently, almost always followed by simple atrophy of the testicle, a fact explained by the blood supply to the testicle from the surrounding fascia, which furnishes sufficient nutrition to prevent gangrene.

IRRITABLE AND NEURALGIC TESTICLE

Irritability or neuralgia of the testicle consists in an abnormal sensitiveness of the whole gland or of some particular part of it. Mere contact of the clothing may be exquisitely painful. In the recumbent posture with nothing in contact with the testicle, the pain usually disappears. In other cases the pain is constant, and perhaps quite mild, but increased by walking and standing so as to occasion great discomfort. The character of the pain is acute and darting, or heavy and dragging. The cremaster contracts spasmodically during severe paroxysms, forcibly retracting the testicle. Between paroxysms the testicle is often entirely free from pain. Handling the organ may perhaps induce a paroxysm. The testis, sometimes swollen and tense, is otherwise unaltered. There is no febrile reaction. Neuralgia is usually confined to one testicle.

Etiology.—Neuralgia of the testis, like that of the ovary, has been attributed to every possible reflex; but certainly its most potent cause is sexual excess or irregularity, frequently that unchaste continence which revels in the paraphernalia of indecency, lewd books, plays, tales, and thoughts, while seeking to hide beneath the cloak of physical propriety. Temporary irritable testis may be produced in a healthy person, at any time, by prolonged sexual excitement ungratified. Masturbators who have suddenly reformed, and those who have abused their sexual powers, are all liable to it. Add to these physical causes a neurotic disposition and the picture is complete.

The more severe forms of neuralgia may be symptomatic of renal or of vesical calculus. Neuralgia is often associated with a small varicocele, rarely with a large one.

It is almost always associated with prostatitis, vesiculitis, or congestion of the verumontanum.

Course.—These patients are prone to become more and more self-centered and to look upon their condition as a pitiable one, ascribing it to loss of seminal fluid—perhaps to nocturnal emissions—to neither of which does it bear any relation.

Treatment.—1. The backbone of the cure is sexual reform. Sexual hygiene, which means strict purity of thought as well as action, must be insisted on. A strict celibacy is usually impossible to such patients, while a happy marriage affords them a natural antidote to the irritability of their sexual apparatus, and is therefore to be urged relentlessly. At the same time the regulation of physical hygiene, exercise, diet, fresh air, regular hours, all must be minutely arranged.

2. Mild cases may be controlled by local applications of ice, or of 10 per cent guaiacol in glycerin, aided by a suspensory bandage.

3. Brilliant cures are sometimes effected by rectal douching, mas-

sage of the vesicles, or cauterization of the verumontanum through the posterior urethroscope.

SYPHILIS OF THE TESTICLE

Syphilis of the testicle is a relatively common and characteristic lesion, which, like the other visceral lesions, is much more often found on autopsy than during life.

I have record of 67 cases, 10 of them bilateral. The following table shows the dates of onset:

4 to 7 months	3 cases
12 to 18 "	5 "
2 years	4[1] "
3 "	9[2] "
4 "	6 "
5 "	1 case
6 "	4 cases
7 "	3 "
8 "	1 case
9 "	2 cases
10 "	1 case
11 "	4 cases
12 "	3 "
15 "	2[1] "
26 "	1 case
31 "	1[1] "
Indefinite	17[3] cases
Total	67 cases

It will be noted that, though three of the cases occurred between the fourth and the seventh month, the lesion is not common during the first year; though over half of the cases occurred within the first four years.

Yet the appearance of syphilis in both testicles is no evidence of a recent syphilis, as shown by its occurrence once in the fifteenth and once in the thirty-first year.

Morbid Anatomy.—The French school, following Dron,[4] recognize a secondary epididymitis and a tertiary orchitis or epididymo-orchitis. The distinction cannot be clinically established. Of my three earliest cases one was distinctly an orchitis, and others have reported similar experiences.

Clinically it is safer to consider all syphilis of the testicle rather tertiary than secondary.

The Testicle.—The syphilitic testicle usually shows marked interstitial sclerosis, sometimes considerable gummatous infiltration. Thus the process is the familiar sclero-gummatous one; but as the inflam-

[1] One bilateral. [2] Three bilateral. [3] Six bilateral.

[4] *Archiv. gén. de méd.*, 1863, vol. ii, pp. 513, 724.

mation is painless and usually progresses very slowly, it may never be discovered at all, or it may almost totally destroy the seminal tubules before the patient considers it worthy of medical care.

Active gummatous orchitis, however, may cause rather rapid enlargement and terminate by involvement of the overlying tissues and eruption through the skin, leaving a typical syphilitic ulcer, in the base of which the tubular structure of the testicle may be discerned.

The Epididymis.—The epididymis alone may be involved (secondary epididymitis of Dron), though more often the testicle is implicated as well. The lesion is usually confined to the globus major, which forms a hard, solid, infiltrated mass with a sharp edge. It caps the end of the testicle, separated from it by a distinct sulcus, so that the organ seems to be resting in a clam shell. Gummatous nodules are very rarely felt in the epididymis. This diffuse infiltration, sharp-edged, not nodular and not sensitive, is very characteristic of syphilis. The French speak of it as a "helmet crest"; the comparison with a clam shell is more familiar to our minds.

I have in one instance seen syphilis begin in the epididymis as a rounded nodule, the size of a marrow-fat pea, and to progress by the addition of other nodules in the epididymis and in the testicle itself. These gummata so closely resembled tubercles that the testicle was removed under a mistaken diagnosis. Such rounded nodules in the epididymis, however, are extremely rare.

The Tunica Vaginalis.—Hydrocele is almost always present, but the amount of fluid is, as a rule, not very great. Adhesive vaginalitis is found after the fluid has been resorbed in the course of a cure.

Symptoms.—The characteristics of the syphilitic testicle are painlessness and slow growth; as a rule but one testicle is involved. It does not attain a very great size; it does not ulcerate through the skin unless it has been neglected for a long time.

Examination reveals a testicle wooden in hardness. If the epididymis is involved, the sharp, clam-shell edge of the globus major (less often the globus minor) can usually be made out without drawing off the hydrocele fluid.

If there is orchitis, the testicle is either generally involved, evenly and densely hard, or else it is of uneven hardness, with projecting small gummata.

The vas deferens was involved in only one of my cases. The general health is not impaired, but, if both testicles are involved, sexual appetite and power are likely to be lost.

The course of the disease is infinitely slow; it terminates either in fungus or in atrophy.

Prognosis.—The prognosis is excellent. Whatever part of the parenchyma has not been destroyed by sclerosis will continue to functionate,

and the testicle which has been syphilitic for years may still secrete spermatozoa. But the patient should be warned that the result of treatment upon an enlarged testicle may be to cause such absorption of the syphilitic tissue as to reduce the gland far below its normal size, while any delay in instituting treatment will only make this atrophy more marked.

The hydrocele disappears with cure of the orchitis.

Diagnosis.—The diagnosis of syphilitic testicle is often easy from the appearance of the organ and the syphilitic history. Exceptionally, the onset of the disease is accompanied by mixed infection, so that for a time the testicle is tender and there is some little temperature.

This mixed infection is not obviously connected with gonorrhea, and usually leads to the diagnosis of tuberculosis; but in a short time the fever and tenderness disappear and the characteristic epididymitis or orchitis remains.

In the later stages the general irregular involvement of the whole gland may lead to a diagnosis of neoplasm; but here the general rule applies absolutely: No testicle should be removed for neoplasm until the patient has been given the benefit of a test course of mixed treatment, which test course should imply hypodermic medication.

The aspirating needle may do good service, both in withdrawing the hydrocele that obscures the outlines of the testicle and in distinguishing between a solid growth and hematocele.

Treatment.—The general treatment is along the usual lines. We may not expect to bring a badly disorganized testicle back to an entirely normal condition. Local treatment is of no value. The hydrocele requires no treatment. Ancient syphilis of the testicle often resists every form of treatment short of mercurial injections.

TUMORS OF THE TESTICLE

Many kinds of morbid growths have been observed in the testicle, although no individual variety is at all frequent. In fact it is impossible clinically to distinguish between the various forms of tumor, and even the pathologists are not agreed. For most tumors of the testicle are mixed tumors, and most of them are malignant.

Benign Tumors.—Enchondroma, fibroma, osteoma, and myoma [1] have been observed. If the tumour is small it is often not discovered until after death. If large it cannot be distinguished from beginning malignant disease.

In the *tunica vaginalis* lipoma (Roswell Park) and fibroma have been observed (Jacobson).

[1] *Cf.* Becker, *Virchow's Archiv*, 1901, clxiii, 244.

Cystic Growths.—From the testicle either dermoid cyst, teratoma, benign cystic disease, or malignant cystic disease may develop. Clinically they cannot be distinguished from one another.

Both simple *dermoid* cysts and more complex *teratomata* are met with in the testicle. In a case of my father's the teratoma contained a malformed mandible bearing several teeth. It is not clear whether teratoma is developed sometimes within the testis or always alongside of it.

Cystic Disease.—Cystic disease (cystic degeneration) is a general term embracing a large class of mixed tumors which have this striking characteristic in common, that they are riddled with cysts, large and small. Benign cystic disease is a cystic fibroma. Malignant cystic disease is sarcomatous, fibro-myxo-sarcomatous, myxomatous, carcinomatous, enchondromatous. Sturgis [1] has given a detailed expression of the views of various authors on this subject, and has collected 40 cases.

The pathogenesis of these tumors is still disputed. Sir Astley Cooper believed that the cysts are derived from dilated canaliculi. Curling alleged that this, like most other tumors of the testis, originates in the mediastinum. Later, Malassez introduced the theory that it is produced in the intertubular connective tissue. Finally, Eve concluded that the cysts probably grow from certain epithelial nests derived from the Wolffian body included in the mediastinum. For him, therefore, cystic disease is a teratoma.

Malignant Tumors.—**Carcinoma.**—Carcinoma and sarcoma have been confused to some extent, owing to the mixed and cystic nature of many of the malignant tumors, and the obscurity which, as we have just seen, still shrouds the pathogenesis of these cystic growths. Carcinoma is not so common as sarcoma. Pure medullary carcinoma is the most common variety. Cystic and chondro-carcinoma have been described. Nepveu alone asserts the existence of scirrhus.

Sarcoma.—Kober [2] has collected 114 reported cases of sarcoma of the testicle. Seventy-one per cent occurred between the ages of twenty and fifty. There was a history of trauma in 43 per cent. The round-celled, small round-celled, and mixed (round and spindle-celled) varieties afforded 65.2 per cent of the 75 cases examined microscopically; 28.9 per cent of the others were of the cystic, alveolar, and spindle-celled varieties.

Lymphadenoma.—The existence of lymphadenoma has been affirmed by the French, notably Malassez, Trélat, and Monod and Terrillon. Morestin and Milian [3] have recently reported a case. The Germans, led by Birch-Hirschfeld and Kocher, class these tumors with small round-celled sarcoma.

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[1] *Am. Med. Quart.*, 1899–1900, i, 110. [2] *Am. Jour. of Med. Sci.*, 1899, cxvii, 535.
[3] *Guyon's Annales*, 1900, xviii, 311.

Jacobson cites 3 cases of pure *myxoma.*

Sarcoma originating in the *tunica vaginalis* has been observed 4 times (Jacobson). Rockwell [1] has reported an alleged bilateral cancer of the *epididymis.*

Symptoms

Since malignant tumors of the testicle often appear benign at the outset, and since apparently benign tumors may, at any time, become malignant, it is quite impossible to say of any given tumor of the

Fig. 121.—Carcinoma of Testicle. The organ is completely destroyed by the growth. There is hydrocele. (Case of Dr. G. D. Stewart.)

testicle at any given time that it does or does not menace its possessor's life. The tumor is not usually noticed until it has involved the entire organ. Carcinoma, apparently, grows more rapidly than sarcoma, and the benign cystic disease may attain a certain size and retain it for many years, although there is no sign to indicate the change which may ultimately alter it into a malignant growth. Thus in one of Conché's cases (Sturgis) the tumor began to grow after having been quiescent for five years. On the other hand, in a case recorded by Socin, in six months the tumor attained the size of a man's head, and Sturgis's case of sarcoma grew in a year to the size of a child's head. Kocher collected 32 cases of carcinoma, 25 of which came under observation within

[1] *Annals of Surgery,* 1888, viii, 446.

Diagnostic Table

	Simple Chronic Epididymitis.	Tuberculosis.	Syphilis.	Tumor.
History.....	Gonorrhea, stricture, or hypertrophy of the prostate.	Tuberculosis, family or personal.	Syphilis, inherited or acquired.	Perhaps trauma.
Frequency	Uncommon.	Frequent.	Frequent.	Rare.
Sensitive.....	Yes.	Yes.	No.	No.
Shape	Between attacks testis normal, epididymis nodular.	Epididymis nodular. Testis not involved unless acute or ancient.	Testis evenly enlarged, slightly nodular. "Clam-shell" epididymis.	Testis considerably enlarged. No characteristic involvement of epididymis.
Cord.....	May be slightly thickened.	Usually enlarged and nodular.	Free.	Free. Veins dilate in later stages.
Seminal vesicles.....	Usually distended.	Tubercular.	Uninfluenced.	Uninfluenced.
Prostate.....	Posterior urethra congested or inflamed.	Congested. May be tubercular.	Uninfluenced.	Uninfluenced.
Urine.....	Cloudy.	Cloudy. May contain bacilli.	Clear.	Clear.
Hydrocele.....	Unusual.	Often.	Nearly always.	Unusual.
Onset.....	Usually acute.	Usually chronic.	Chronic.	Chronic.
Course.....	Recurrent acute attacks.	Usually chronic.	Chronic.	Chronic.
Opposite testicle.....	Often involved simultaneously.	Usually involved subsequently.	Free, usually.	Free.
Abscess.....	Unusual.	Common.	Rare.	None.
Atrophy of testis.....	Rare.	Rare.	Common.	Never.

a year and a half of the beginning of the disease, and of which only 1 had lasted six years—an average of one year and four months; while 83 of Kober's sarcoma cases show an average of two years and eight months from the beginning of the disease to the time of operation. As the tumor is commonly accompanied by hydrocele, the absorption of this fluid sometimes causes an apparent recession in the size of the tumor which the surgeon should not allow to mislead him. The pain is often slight throughout, though it may well become severe in the later stages. Testicular sensation is lost.

The oval shape of the testicle is preserved. As the tumor grows it becomes uneven on its surface, nodular, elastic in places, perhaps fluctuating when there are large cysts or a flaccid hydrocele. Finally, the scrotal veins enlarge, the iliac and lumbar glands can be felt by deep abdominal palpation, and, ultimately, the tunica albuginea gives way and elastic masses can be felt projecting through it. Thence the fascia and skin are involved and the tumor eats its way through the tense in-

tegument, forming the malignant fungus, the *fungus hematoides* of the testicle. This occurred only once in Kober's 114 cases of sarcoma, but it is more frequent in the rapidly growing carcinoma. The inguinal glands do not enlarge until the scrotum becomes invaded by the growth, for the lymphatics from the testicle run directly up the cord to the iliac and lumbar glands.

Diagnosis

The diagnosis of one new growth of the testicle from another is usually impossible, always unnecessary. The diagnosis between the various chronic diseases of the testicle is given on page 635. Unless the case is absolutely clear-cut, the aspirator and antisyphilitic remedies should be allowed a share in the diagnosis. It is well to remember that every neoplasm of the testicle is possibly syphilitic until the contrary is proved. A short, sharp course of mixed treatment with iodids in excess will decide.

At the end, as at the beginning, the iodids with mercury, and the aspirator.

Treatment

The treatment of neoplasm is castration with excision of the iliac glands.

CHAPTER LX

HYDROCELE, HEMATOCELE, SPERMATOCELE, CHYLOCELE

Hydrocele is usually defined as an accumulation of serous fluid in the tunica vaginalis. This definition covers the ordinary cases; but hydrocele may also occur in the funicular process of the peritoneum (encysted hydrocele of the cord) or in the form of a number of cysts about the head of the epididymis or along the cord (encysted hydrocele). The fluid may be bloody (hematocele) or milky (chylocele). Serous hydrocele of the tunica vaginalis concerns us here.

Varieties.—Hydrocele may be idiopathic or symptomatic. It may be acute or chronic. While all idiopathic cases are chronic, not all symptomatic cases are acute, therefore the terms are not quite interchangeable.

SYMPTOMATIC HYDROCELE

As its name suggests, symptomatic hydrocele occurs only as a symptom of disease in the testicle and epididymis. It is often acute, and is especially common with acute epididymitis, syphilis, and the more acute forms of tuberculosis. Hydrocele also accompanies quite frequently all other diseases of the testicle and epididymis. A *fibrous vaginalitis* has been identified postmortem or during operation. It gives no clinical symptoms. The *serous vaginalitis,* as symptomatic hydrocele is sometimes called, rises and falls with the disease of which it is a complication. It is acute with acute disease, chronic with chronic disease. Injections into the vaginalis may cause an acute hydrocele.

Treatment.—The treatment of symptomatic hydrocele is, in some degree, comparable to the treatment of serous pleurisy. If the primary disease is acute and the hydrocele insignificant, it may be disregarded and allowed to be absorbed as the acute disease abates. If large and tense, or its absorption too slow, it may be aspirated one or several times. But if the primary disease is chronic, while aspiration may hold the hydrocele in check, some more radical procedure is often demanded. The treatment by injection, which is so habitually successful in idiopathic hydrocele, may be tried, but it often fails. The need of a more radical procedure may prove the surgeon's opportunity to induce the

patient to submit to an operation upon his testicle from which he otherwise would shrink.

IDIOPATHIC HYDROCELE

Most French writers maintain that there is no such thing as idiopathic hydrocele, that every *vaginalite séreuse* is symptomatic. This theory I cannot accept, since it does not explain why idiopathic hydrocele is so common in the tropics, or why idiopathic hydrocele does not often follow acute epididymitis, a disease which leaves far greater changes in the epididymis than those alleged as cause of idiopathic hydrocele.

Varieties.—Hydrocele is usually confined to the tunica vaginalis (Fig. 122). In infants, however, it may occur before the funicular process has begun to close (*congenital hydrocele*), so that the cavity of the hydrocele communicates with the peritoneal cavity, yet by such a small opening that there is often no hernia and the fluid does not spontaneously drain off into the abdomen (Fig. 124). A more frequent variety is *infantile hydrocele,* occurring when the funicular process has quite closed at its upper end, so that the fluid distends both vaginalis and funicular process (Fig. 125). Hydrocele occurring in a retained testis is termed *inguinal hydrocele.* These and other varieties mentioned above will be dealt with later.

Fig. 122.—Usual Form of Hydrocele.

Etiology.—Hydrocele does not occur as a dropsical phenomenon, and it has already been distinguished from inflammatory or symptomatic vaginalitis. It is possible that certain cases are due to the bursting of an epididymal cyst into the tunica vaginalis,[1] but beyond this we are quite in the dark as to its cause.

Hydrocele is most common in the middle-aged. In the tropics it is said to afflict one man in ten. It is far less common in temperate climes.

Pathology.—*The Character of the Fluid.*—The fluid of hydrocele is viscid, odorless, straw-colored, clear, or opalescent. It looks like blood serum. Its specific gravity is about 1.024. It contains about 6 per cent of organic matter, notably fibrinogen, to which it owes its property of

[1] *Lancet,* 1885, i, 748.

coagulating blood serum. The alkaline carbonates and sodium chlorid are present in some quantity. The reaction is neutral. The presence of fibrinogen and inorganic salts distinguishes it from ascitic fluid. It may contain a few flakes and strings resembling urethral shreds. It is sometimes full of bacteria, sometimes brown from the admixture of blood. These bacteria and this blood are usually the result of previous punctures. The microscope reveals blood and epithelial cells and leukocytes. Cholesterin crystals are usually present, not often in any numbers. Suppuration is rare.

The Quantity of Fluid.—A good-sized hydrocele contains some 200 or 300 c.c. of fluid. Mr. Cline removed 6 quarts from the scrotum of Gibbon the historian. Breisson, after removing 16 liters on one occasion, drew 26 liters from the same patient ten months later. It takes from three months to a year for a good-sized hydrocele to refill after tapping. The largest hydroceles I ever operated upon held 2,500 c.c. and 1,500 c.c. (right and left sides of the same patient).

The Tunica Vaginalis.—The sac of a hydrocele may remain normal in structure even after the disease has existed for some time. Support to the testicle and systematic tapping may prolong this condition indefinitely. But if the scrotum is not supported, the slight bruising which the tumor continually suffers may produce a chronic thickening in the tunica vaginalis; the surface loses its gloss and becomes wrinkled and irregular, while the vaginalis becomes thick and leathery. Adhesions and masses of fibrin result from inflammation and are features of inflammatory, but rare in idiopathic, hydrocele. Obliteration of some part of the sac may subdivide it, causing the rare *multilocular hydrocele.* I have once met with *calcification of the vaginalis,* a very rare condition, which has been exhaustively described by Roswell Park.[1]

The Testicle and Epididymis.—Unless inverted or displaced by adhesions, the testicle lies below and behind the hydrocele. In mild cases the testicle remains normal, but after evacuation of the fluid one or more areas of induration may commonly be found in the epididymis. These are points of intertubular edema due to the interference with circulation. In old and inflamed cases of hydrocele, both testis and epididymis may be quite sclerosed and so atrophied as to be scarcely recognizable in the sac wall. Sometimes the tunica vaginalis forces its way between the testicle and epididymis, forming quite a pouch there.[2]

Multilocular Hydrocele.—Multilocular hydrocele is quite rare. It may be produced in one of three ways:

1. Several varieties of hydrocele exist simultaneously (e. g., hydrocele of the vaginalis and hydrocele of the cord).

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[1] *Jour. of Cut. and Gen.-Urin. Diseases,* 1895, xiii, 361.

[2] Cf. Jacobson, *op. cit.,* p. 134.

2. The sac becomes subdivided by adhesions.
3. There is hernia of the sac between testis and epididymis.

Fibrous Bodies.—The so-called fibrous bodies occasionally met with upon opening a hydrocele are concretions of earthy phosphates or carbonates covered with fibrin. Probably they are for the most part due to a deposition of the hydrocele salts upon some warty growth, followed by atrophy of the little nucleus, after which the concretion breaks free. Wendlung met with concretions 6 times in 109 operations (Péraire [1]). They do not exceed the size of a pea—though Chassaignac found one 2 cm. long and 12 mm. wide—and are usually single.

Symptoms.—Idiopathic hydrocele is always chronic. The effusion takes place slowly and painlessly, and the swelling is only discovered

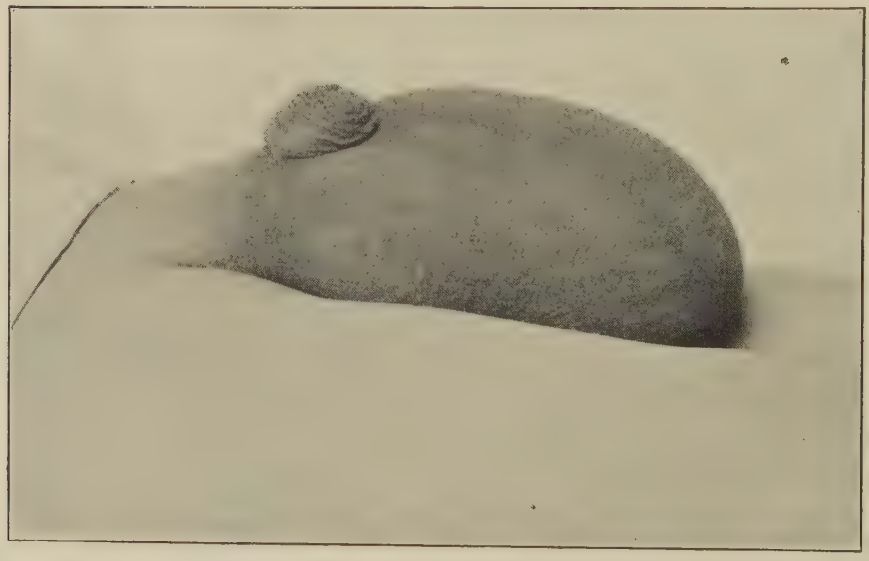

Fig. 123.—Hydrocele.

after it has attained some size, for which reason the patient fancies it has appeared suddenly. The accumulation of fluid is slow and interrupted, but continues indefinitely. After tapping, the reaccumulation is at first rapid and then slow until the tumor reaches its original size, usually several months after tapping. Thus I have a patient who, refusing any radical measures, has returned twice a year since 1895 to be tapped, having, for a number of years previous to that date, visited other surgeons for the same purpose.

There are no subjective symptoms attached to hydrocele, except the

[1] *Bull. de la soc. anat.*, 1899.

sensation of dragging felt in the loin and groin from the weight of the tumor.

Signs.—Hydrocele is usually pear-shaped, larger below than above; or it may be oval, and, if very large, sausage-shaped. It cannot be reduced by pressure. Fluctuation can usually be made out. The tumor is generally tense, the scrotum often stretched and shining. The cord, of natural size and feel, can be grasped above the tumor. The testicle is usually situated behind, a little below the center (Fig. 122), and pressure on this point gives rise to the peculiar sensation experienced when the testicle is squeezed. Occasionally the testicle is found below and in front, more rarely in the center, in front, from plastic adhesion. Its position should always be ascertained before operating on a hydrocele. Pressure on a hydrocele does not produce pain; there is no heat or redness of the skin unless the tumor be large enough to keep it constantly on the stretch. There is flatness on percussion. There is no impulse on coughing. Exceptionally a large hydrocele extends into the inguinal canal, but even then the cough impulse is lacking unless there is hernia.

The weight of the tumor is a criterion that has been much depended upon to distinguish solid from fluid tumors. It is absolutely unreliable.

Varicocele and hernia may complicate hydrocele, and the pressure on the testicle may render it sterile. But if the hydrocele is cured the testicle will resume its functions unless it has become atrophied.

Diagnosis.—The diagnosis is made by three tests:

1. The light test.
2. Isolation of the tumor.
3. Puncture.

The Light Test.—Most hydroceles are so thin-walled that if an electric bulb or a candle is held close to one side of the tumor and the opposite side inspected through a tube (e. g., a roll of paper), the whole mass glows with a pinkish light. The position of the testicle may even be discerned by its shadow.

This test rules out hematocele and solid tumors of the testicle, but does not exclude a complicating hernia.

If the walls of the hydrocele are thickened, the light test fails.

If the test fails in a case that has every other aspect of hydrocele, it is doubtless a spermatocele.

Isolation of the Tumor.—If the fingers can be brought together above the tumor and feel nothing but the normal tissues of the cord, hernia is excluded.

If the tumor runs into the inguinal canal and gives no impulse on coughing, there is *probably* no hernia.

Puncture.—The tumor should not be punctured unless hernia can be *absolutely* excluded by isolation of the tumor. Puncture is, of course, the final diagnostic test.

Prognosis.—Hydrocele in the adult does not get spontaneously well. Suppuration and transformation into hematocele are rare. Spontaneous cures have been recorded after an infectious disease (Monod and Terrillon), sloughing of the scrotum (Cooper), rupture, and epididymitis. Such spontaneous cures are most unusual, except in the young. Curling cites the case of a Spaniard who had ruptured his hydrocele thirty times by horseback riding and other violent exercises; yet the swelling always returned after a few months. Infants often get well spontaneously, and expectant treatment is therefore most suitable for them.

Treatment.—*Tapping.*—This is appropriate to symptomatic hydrocele, for children—for whom it is often curative—and for patients refusing radical measures. Before tapping for hydrocele the testicle must be accurately located by the testicular sensation or the light test, and hernia must be *absolutely* excluded.

Hydrocele in the adult will usually refill after this operation, but for children it often suffices, especially if the internal surface of the sac be scratched. If the cyst wall be thick and the tumor not translucent, neither tapping nor acupuncture will ever effect a cure. The patient can put on a suspensory bandage and resume work at once after tapping.

Radical Treatment.—Of the many methods of treating hydrocele only two need be detailed—namely, injection and incision (including excision of the tunica vaginalis).

The choice between these operations is discussed in Chapter XC.

CONGENITAL HYDROCELE

In congenital hydrocele there has been no obliteration of the peritoneal prolongation, and the tunica vaginalis is continuous with the peritoneum (Fig. 124). Congenital hydrocele is idiopathic, traumatic, or perhaps due to gravitation into the sac of an excess of the peritoneal fluid. It occurs in infancy.

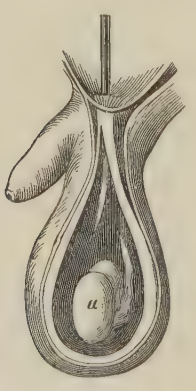

Fig. 124.—Congenital Hydrocele.

Fig. 125.—Infantile Hydrocele.

Diagnosis.—The diagnosis is usually easy, but in certain cases there is some danger of confusion with hernia.

CONGENITAL HYDROCELE	HERNIAL TUMOR
1. Appears soon after birth.	1. May appear at any time.
2. Tumor continues into inguinal canal.	2. Same.
3. Impulse on coughing.	3. Same.
4. Flatness on percussion.	4. Resonance on percussion.
5. Always reducible at an even rate, more or less rapidly according to size of opening; no jerk; no gurgle.	5. If reducible, goes back suddenly, with a gurgling sound.
6. Testicle, entirely obscured by the tumor, reappears on the reduction of the latter.	6. Testicle can be usually made out as a distinct lump.
7. Feel soft, not doughy; no gurgling.	7. Doughy feel—perhaps gurgling—on manipulation.
8. Always translucent.	8. Never translucent.

Congenital hydrocele and hernia usually coexist.

Congenital hydrocele may be found in adults, but is rare. Horwitz met with it once in 110 cases. Kocher estimates that it occurs 4 times in every 100.

Treatment.—Open operation; never injection.

INFANTILE HYDROCELE

Infantile hydrocele is far more common than the congenital variety. Horwitz met with 22 cases. The hydrocele occupies the tunica vaginalis and the funicular process up to the inguinal canal, where it is shut off from the general peritoneal cavity (Fig. 125). It resembles a congenital hydrocele, but is quite irreducible.

Treatment.—Since these hydroceles are usually complicated by hernia, they should never be injected, always subjected to open operation.

Abdominal Hydrocele (*Bilocular hydrocele, hydrocèle en bissac*).—This is a very rare variety of infantile hydrocele, in which the hydrocele is partly in the scrotum, partly in the abdomen. The abdominal portion, which may grow to an enormous size, usually lies between the general peritoneal cavity and the anterior abdominal wall.

Treatment.—Open operation.

ENCYSTED HYDROCELE OF THE CORD

There are three conditions commonly grouped as encysted hydrocele of the cord, viz.:

1. Hydrocele of the processus funicularis.
2. Pedunculated cysts of the epididymis.
3. Hydrocele of an old hernial sac.

1. **Hydrocele of the Processus Funicularis.**—The sac is shut off below from the tunica vaginalis, above from the peritoneum. The hydrocele may be single or multiple (*hydrocèle en chapelet*). Usually single, it presents the features of a hydrocele of the tunica vaginalis, but is situated above the testicle and about the vas. Sometimes it may be reduced into the inguinal canal, but never into the abdomen. Although it usually occurs in children, I have several times seen it in the adult.

2. (See below.)

3. **Hydrocele of an Old Hernial Sac.**—This occurs in the process of peritoneum left behind by a hernia which has been reduced and the neck of the sac closed, either spontaneously or by the use of the injection cure for hernia. The hydrocele is usually mistaken for a recurrence of the hernia.

Treatment.—For large encysted hydrocele of the cord injection is the best treatment. For small cysts, as well as for multiple and multilocular cysts, incision is the best treatment. Incision is indispensable for cysts situated within the inguinal canal or where there is any doubt as to hernia.

Hematocele.—Hematocele of the cord is rare, but may occur in the same way as hematocele of the tunica vaginalis, usually after injury. Indications for treatment are the same.

INGUINAL HYDROCELE

Hydrocele about a retained testis is one of the indications for operation upon that organ.

MULTILOCULAR HYDROCELE OF THE CORD

Multilocular hydrocele of the cord was first described by Pott and Scarpa as diffuse hydrocele of the cord, and most authors retain that title. The pathogenesis of this rare affection is habitually misunderstood. Kocher,[1] however, after a critical survey of the literature, concludes that an actual diffuse hydrocele can be due only to a rupture of some hydrocele or spermatocele, a temporary accumulation of fluid in the connective tissue about the cord. All other cases he classifies under five heads, viz.:

1. Echinococcus cyst.
2. Spermatocele.
3. Encysted hydrocele of the cord subdivided into loculi by adhesive inflammation.

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[1] *Op. cit.*, pp. 170, 180.

4. Cysts of fetal remains (Müller's Duct, Wolffian Body, Organ of Giraldès).

5. Cystic lymphangioma.

Symptoms.—The symptoms are characteristic, whatever the nature of the disease. The tumor extends about the cord from the testis up or into the spermatic canal. It is smooth, rounded, translucent, and boggy rather than fluctuating, though a difference in this regard may be made out in different parts of the tumor. It may be partly reducible. There is a slight impulse on coughing.

Diagnosis.—The diagnosis from encysted hydrocele of the cord is established by the boggy feel and the irregular, indistinct outlines of the tumor. In fact, it resembles an incarcerated omental hernia in everything but its translucency and its fluctuation in places. Incision may be required to establish the diagnosis.

Treatment.—The tumor may safely be let alone. To cure it incision has usually been employed. Pott's classical case of lymphangioma died of lymphorrhagia after incision.

CYSTS OF THE EPIDIDYMIS—SPERMATOCELE

This condition, commonly known as spermatocele or encysted hydrocele of the testicle, is a collection of fluid "contained in a cyst or cysts, distinct from but close to the cavity of the tunica vaginalis" (Jacobson). These cysts are developed in and about the epididymis, very exceptionally in the testicle itself, and should be classified as epididymal cysts. Two classes may be recognized:

1. Small cysts developing (usually) about the epididymis.
2. Large cysts originating within the epididymis.

1. The *small cysts* are rarely encountered before middle age, while they are very common in later life. They usually project more or less distinctly from the head of the epididymis, often into the tunica vaginalis, where their rupture is among the possible causes of hydrocele, and their detachment the origin, perhaps, of calculi. They do not attain any notable size; they rarely contain spermatozoa—in short, they have little clinical significance.

2. The *large cysts* are found in the epididymis rather than projecting from it. They usually appear before middle age and commonly contain spermatozoa. They are often multiple and grow between the epididymis and the testicle, separating them and unraveling the former. Thus they form irregular fluid tumors about the top of the gland. Exceptionally, the cysts are pedunculated and grow upward, simulating hydrocele of the cord.

I have seen two cases that precisely simulated hydrocele of the tu-

nica vaginalis in every respect except translucency. They had doubtless ruptured into the vaginalis.

These cysts rarely contain more than 100 c.c. of fluid, though Curling drew off 32 ounces from one individual and 40 ounces from another. Jacobson mentions a case from whose right side 49 ounces were drawn, and 58 from the left. Frost's [1] cases yielded 52 ounces. The nature of these large cysts is identified by the fact that the fluid is milky and swarming with spermatozoa.

Pathogenesis.—Since the smaller cysts are met with later in life than the larger, and less frequently contain spermatozoa, many authors attribute the larger cysts to persistent fetal remains, such as the vasa aberrantia, the hydatid of Morgagni, or the paradidymis (organ of Giraldès), and the smaller cysts to dilatations of the seminal canals. The recent tendency, however, has been to discredit the claims of the fetal elements, and to attribute the earlier and larger cysts to dilatation of the vasa efferentia or of the epididymis itself behind an obstacle more or less impervious,[2] and the later, smaller tumors to a cystic enlargement of the tubules due to senile changes after the organ has passed the height of its activity.

The presence of spermatozoa in the cysts is explained by those who cling to the theory of embryonal rests upon the ground that the cyst has burst into the epididymal canal. *The absence of spermatic elements* is explained by those of the opposite camp on the ground that the cysts become occluded from the main channel and their seminal elements gradually disintegrate. The communication between a cyst and a seminal duct has been observed a number of times.

Symptoms.—The *small cysts* are occasionally met with in older men. They produce no symptoms.

The *large cysts* have peculiar features. If seen early, an undefined sense of thickening, with extra resistance, is distinguishable by the finger in the region of the top of the testicle. This goes on increasing, usually at so slow a rate that the patient soothes himself with the idea that it will become no larger. It grows constantly, however, and may attain a large size. There is no pain, except a slight dragging on the cord. The cyst keeps its position at the upper end of the testicle, or extending down in front of it. It may be "heart-shaped," the testicle lying below the cyst which is notched above. The walls are usually

[1] *Lancet*, 1878, ii, 483.

[2] Griffiths (*Jour. of Anat. and Phys.*, 1893–94, xxviii, 107) maintains that, like hydronephrosis, these dilatations are caused by partial obstruction due, in this case, to catarrhal inflammation. He also maintains that the hydatid of Morgagni is always a solid body, never cystic, and that there is no evidence that embryonal remains are in any way connected with spermatocele.

thin and tense, so that fluctuation cannot always be distinguished. Translucency is rarely present.

The cyst tends to increase in size indefinitely. It may coexist with hydrocele and be masked by it. It may be broken into the vaginalis by accident, and, continuing to secrete, form spermatic hydrocele, or it may be punctured when a supposed simple hydrocele is tapped.

Diagnosis.—The heart shape of the cyst, though pathognomonic when present, is not constant. The diagnosis is usually made by the irregular shape and position (above and behind the testicle) of the tumor and the presence of fluctuation over irregular areas. Aspiration usually completes the diagnosis by withdrawing a milky fluid full of spermatozoa. If the fluid is limpid it may be distinguished from hydrocele fluid by its watery limpidity (whereas hydrocele fluid is straw-colored), its neutral reaction, its low specific gravity (less than 1.010), and its low percentage of albumin (about ½ per cent against 4 per cent to 7 per cent in hydrocele). When hydrocele and spermatocele coexist the latter is not discovered until the former is tapped.

Treatment.—A cure rarely results from aspiration and injection of carbolic acid through the same needle. The cyst should be excised. There is no object in disturbing small cysts.

HEMATOCELE

The term *hematoma* is applied to a tumor caused by the effusion of blood into the tissues, whether of the testis or the scrotum. If the effusion becomes encysted, or if it occurs within a cyst or the serous tunic of testicle or cord, *hematocele* results (Fig. 126). I have seen a hematospermatocele.

Etiology.—The most common cause is a crushing injury. Any operation upon the testis may result in hematocele.

Scrotal hematocele and testicular hematocele are always traumatic. Vaginal hematocele is usually traumatic, but, exceptionally, may have a spontaneous origin from active or passive hyperemia; or, rarely, from a hemorrhagic secretion in scorbutic individuals.

Symptoms.—There are consequently two varieties. The one comes on rapidly after injury and is attended by scrotal hematocele. If there has been a preëxisting cyst or hydrocele this becomes suddenly larger, more tense, and painful.

In the other, or spontaneous variety, the tumor increases slowly in size and simulates hydrocele, except in regard to translucency.

The blood in hematocele may be found red and fluid, but is usually black or brown, and it may be mixed with pus if severe inflammation has followed its effusion. The walls of the cyst may be coated with layers of fibrin, and they tend to thicken and become adherent to the

surrounding connective tissue, while the inner surface becomes rough and uneven, resembling anything but a serous surface.

Diagnosis.—The diagnosis of hematocele of the second or spontaneous variety presents many difficulties. Here there is no guide in the

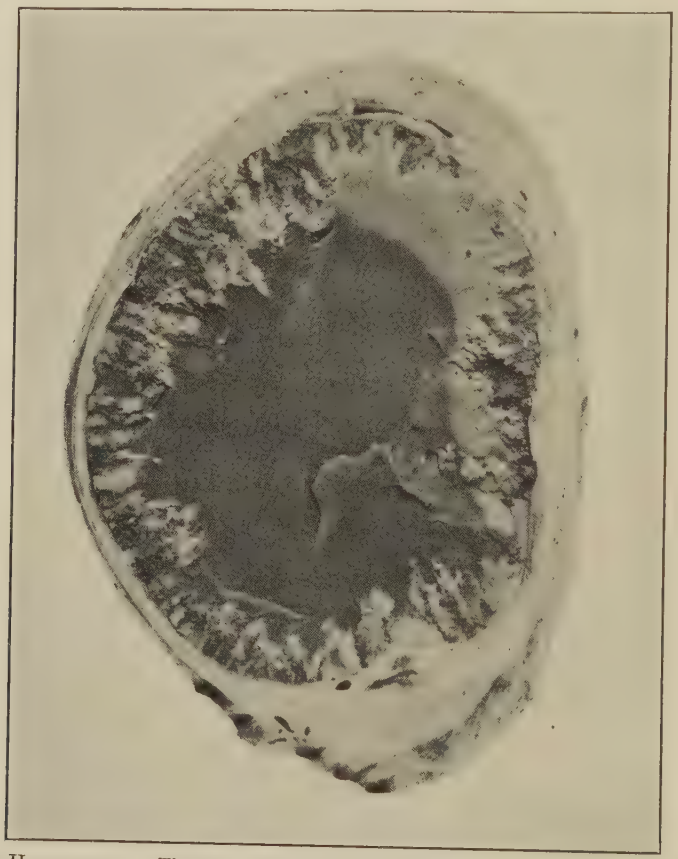

FIG. 126.—HEMATOCELE. The sac is filled with hardening jelly: hence the mosslike fringe. The slight thickening at the bottom is all that remains of the testicle.

history nor any local signs of injury. The records of surgery possess many cases where perfectly healthy testes, surrounded by a hematocele inside of a thickened tunica vaginalis, have been extirpated as cancerous. The diagnosis cannot be made without an exploratory incision.

In the traumatic variety, the diagnosis is made at once from the history. It is unimportant, often impossible, to distinguish between traumatic hematocele of testis, vaginalis, and scrotum.

Treatment.—For *hematoma* all that can be done is to keep the patient upon his back, with the testicle supported and covered with cold lotions, administering perhaps an occasional laxative and an anodyne

if the pain be severe. If the quantity of blood effused is not too great, the pain will soon begin to subside, and the patient may be allowed to go about with a suspensory bandage. The blood will gradually be absorbed.

If, in spite of these means, *which will rarely be found to fail,* blood continues to be poured out into the cavity of the vaginalis so that the pain becomes excessive, and the tension of the parts great, the tumor should be incised and drained.

Ancient hematocele demands castration.

CHYLOCELE

Chylocele (fatty, milky, chylous hydrocele, galactocele) is an accumulation in the tunica vaginalis of chyle or fatty lymph. It is a feature of lymph scrotum, and is caused by the rupture of a dilated lymph vessel into the tunica vaginalis. Filarial embryos have been seen in the fluid by Martin and Davies. Chylocele may also be due to traumatic rupture of a lymphatic into the tunica vaginalis. False chylocele is due to a fat- or cholesterin-producing degeneration in the fluid or in the epithelium of a hydrocele.

Chylocele when occurring without lymph scrotum resembles hematocele. The treatment is excision.

CHAPTER LXI

DISEASES OF THE VAS DEFERENS AND SPERMATIC CORD

ANATOMY

The *cord* is made up of the vas deferens, the habenula or remains of the funicular process of the peritoneum, and certain vessels and nerves, all held together by meshes of connective tissue containing unstriped muscular fiber (internal cremaster of Henle). Surrounding these is a continuous layer of connective tissue (tunica vaginalis communis) adherent to the tunica vaginalis below and continuous with the fascia transversalis above. Outside of this the cremaster muscle lies in loops, some of them embracing the testicle, others extending only a short distance down the cord.

The *arteries* are, the spermatic from the aorta, the deferential from the superior vesical, and the cremasteric from the epigastric. The *veins* from the testicle and epididymis unite in the *pampiniform plexus* which constitutes the bulk of the cord. The larger veins have valves; they usually unite to form one large trunk, which empties, on the left side into the renal vein, on the right side into the ascending cava. The spermatic plexus of *nerves* is derived from the renal, the aortic, the superior mesenteric, the hypogastric, and the lumbar plexuses of the sympathetic, the genital branch of the genito-crural nerve supplying the cremaster and the inguinal branch of the ilio-inguinal.

The *cremaster* muscle varies in size and power in different subjects. Its function is to assist in sustaining the testicle by its tonic contraction, and to compress the organ during the sexual orgasm. The muscle is subject to painful spasmodic contraction in kidney colic, in neuralgia of the testicle, and sometimes in connection with prostatic or urethral irritation. The *cremasteric reflex* is the retraction of the testicle caused by irritation of the adjoining portion of the thigh.

The Vas.—The vas deferens is the excretory duct of the testicle. It runs upward from the tail of the epididymis to form one of the chief constituents of the spermatic cord. It lies in the inner and posterior portion of the cord, where it may be identified as a rigid tube, the only element of the cord that does not slip almost insensibly from between the examining fingers. After passing through the inguinal canal the

vas curves obliquely downward and backward over the base of the bladder, crosses behind the ureter and runs to the inner side of that duct, separated from it by the seminal vesicle. At this point it becomes markedly sacculated, forming the *ampulla* of the vas, then narrows to its original dimensions, and is joined by the duct of the seminal vesicle to form the *ejaculatory duct*, which pierces the prostate and opens into the posterior urethra just in front and to one side of the verumontanum.

The vas deferens is lined throughout with columnar epithelium. Its muscular coat consists of two layers, the inner circular, the outer longitudinal. Surrounding all is a dense fibrous tissue.

Relations.—The chief relations of the vas have been described above. In the scrotum it is closely surrounded by its own artery and one or two small veins. These vessels and the nerves run near it, and, except for a few veins to the inner side, the whole pampiniform plexus lies to its outer side.

ANOMALIES

Curling [1] relates a number of cases reported by various authors, in which the vas deferens was absent wholly or in part, on one or both sides. When the testicular end is missing the epididymis may or may not be missing as well.

INJURIES

Wounds.—Wounds of the cord may cause profuse hemorrhage and rupture of the vas. The hemorrhage may be checked readily enough. If the vas is cut it should be united by Belfield's method (p. 932). If some such operation is not performed, the duct becomes occluded, and, although this does not cause atrophy of the testicle, yet it shuts off the spermatozoa of that side of the urethra.

Complete division of the cord causes atrophy of the testicle. Division of the pampiniform plexus causes only a temporary edema.

Torsion of the Cord.—(See p. 627.)

INFLAMMATION

Inflammation of the vas is usually incident to gonorrheal or tubercular epididymitis. It is rarely of any importance, unless an abscess forms. If this occurs in the scrotal portion of the duct it may be incised, if in the pelvic portion its existence is unsuspected, and it has been known to result in a fatal peritonitis.

Hydrocele and Hematocele.—(See p. 643.)

[1] "Diseases of the Testis," 4th ed., 1878, p. 7.

VARICOCELE

Varicocele is varicosity of the veins of the pampiniform plexus. It may be either symptomatic or spontaneous.

Symptomatic Varicocele.—Symptomatic varicocele is rare. It is caused by the pressure of some intra-abdominal growth obstructing the spermatic veins. The tumor is usually of renal origin and malignant (p. 542).

Diagnosis.—Symptomatic varicocele cannot be mistaken for spontaneous varicocele. It develops very rapidly, late in life, on either side; is painless, attains a large size, and is associated with a palpable abdominal tumor, against which the treatment should be directed.

Spontaneous Varicocele.—Varicocele in a mild form is perhaps the most common affection of the genital organs. It has been estimated that about 10 per cent of males have slight varicocele.[1] It occurs almost invariably on the left side; when very marked on this side it may exist slightly on the right. Pott met with it only once on both sides. Breschet, in 120 operations, operated only once on the right side. I have never operated on both sides.

Most slight varicoceles are encountered in young unmarried men; the affection rarely commences after twenty-five; it is unusual to find it in a married man whose sexual relations are satisfactory. The chief factor in its production is ungratified sexual desire, unrelieved erotic fancies, or, less often, the opposite condition, abuse of the sexual powers, by which the veins are kept constantly engorged. The slight turgescence of the veins constituting varicocele in a young bachelor and often causing him incessant and needless alarm, disappears after marriage, together with the uneasy sensations which accompanied it.

Old men whose testicles are inactive rarely have varicocele, though their legs show many tortuous veins. This fact is of the utmost importance. That slight varicocele is often a sexual derangement, a functional disorder depending upon vicious sexual hygiene, is not sufficiently emphasized by text-books, or appreciated by practitioners. In many cases young men distress themselves unceasingly, and importune their surgeons for an operation to cure a disorder which would be more speedily and effectually removed by marriage.

The degree of varicocele alluded to above may be dismissed briefly. The vessels are a little full, the cord loose, feeling like a small bundle of earthworms, no one vessel being exceptionally large; the testicle is perhaps oversensitive, and there is usually a slight dragging sensation in the groin, but beyond this nothing except the fancied ills and the

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[1] Bennett estimates 7 per cent, while Senn states that among 9,815 recruits 2,075 were affected with varicocele.

hypochondriacal complainings of the young man who is cheating Nature or abusing her gifts. The proper treatment of such cases is found in the employment of all hygienic and tonic measures. The patient's mind must be diverted, he must be dissuaded from an operation, told to wear a snugly fitting suspensory bandage, and if possible to forget his sex until marriage affords him an opportunity to get well. The free local application of cold water daily is a very useful adjuvant.

Yet varicocele serious enough to constitute a disease and to demand active surgical measures for its relief does occur. It is an exaggeration of the milder form; it comes on in early manhood, and has no connection with varices of the legs or anus (hemorrhoids).

Pathogenesis.—Any theory to be adequate must explain the prevalence of the disease among the adolescent and its occurrence, almost entirely, upon the left side.

Many authors look for an anatomical predisposing cause. Thus certain French writers invoke a preëxisting phlebitis. Bennett [1] and Spenser [2] suppose a congenital anomaly of the veins. Such predisposing causes are not generally accepted. Sufficient anatomical predisposition is found in the position of the veins, dependent, unsupported, surrounded by the loosest kind of a fascial envelope. To this add the congenital congestion set up by the untamed and pampered passions of youth, and no further predisposing cause is necessary.

But why should the varicocele occur upon the left side? To answer this question an infinite variety of theories has been proposed. There is space to enumerate only the more important ones. The left testis hangs lower than the right, and the left renal vein is higher than the opening in the cava which receives the right spermatic vein, hence the left vein is longer than the right. To this add the fact that the left spermatic vein, entering the renal vein at right angles, is not affected by suction as is the right vein which enters the cava at an acute angle. So far we are on safe anatomical ground; beyond all is theory. Perhaps, as has been alleged, right-handed men transmit the force of their exertions to the left foot by means of the abdominal muscles of the left side. But I have seen left-handed men with varicocele, always on the left side. Perhaps the sigmoid flexure, overloaded with feces, presses upon the veins. But this is as rare in youth when varicocele is common, as it is common in old age when varicocele does not occur. Curiously enough the ovarian veins are very rarely varicose, except on the left side.

A violent strain may induce acute varicocele.

Pathology.—In mild cases the veins are merely tortuous and dilated. But in a full-formed varicocele the vessels are elongated, their valves

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[1] "On Varicocele," London, 1891. [2] *St. Barthol. Hosp. Rep.*, 1887, p. 137.

broken down, their walls affected by fatty atrophy, and thickened, as is also the surrounding connective tissue. The veins sometimes contain phleboliths.

Symptoms.—I have seen a number of cases of *acute varicocele* resulting from straining, or coming on spontaneously. I have seen it last a number of weeks, and occasionally leave slight permanent enlargement of the veins of the cord.

Except in acute cases, such as those just detailed, *varicocele comes on gradually,* and is discovered by accident. The amount of *pain* complained of varies greatly; a very large varicocele is often attended by absolutely no pain, while a very slight enlargement of the veins may give rise to considerable uneasiness extending up the back and down the thigh, perhaps amounting to neuralgia of the testis. Landouzy has noticed that the symptoms are markedly relieved during and immediately after coition, but become worse on the following day.

The only *general symptoms* in varicocele besides pain are those of hypochondria and defective *morale*, so common in all affections of the genital organs. The impotence often alleged by physicians of an incredible "years' experience" to result from varicocele is the veriest fiction. When impotence and varicocele coexist they are due to the same causes; but neither is the impotence due to the varicocele nor the varicocele to the impotence.

The *local conditions* are typical. The left testicle hangs considerably lower than the right, borne down, and perhaps completely surrounded by the mass of dilated veins. The mass feels soft, like a bunch of earthworms. In bad cases the testicular scrotal veins may be similarly affected. The scrotum is thin and relaxed, the dartos powerless. In long-standing cases of severe varicocele the testis gradually atrophies because of the interference to its circulation. This result is in no way due to the weight of the mass of veins.

The course of the disease is usually not progressive. Of the many men who have slight varicocele, only the smallest percentage fail to get well under the regulated sexual exercise of married life. Exceptionally, however, the veins do grow and enlarge indefinitely.

Diagnosis.—There are few diseases more readily recognizable than varicocele; the peculiar appearance and wormy feel of large tortuous veins can scarcely be confounded with anything else, except, possibly, omental hernia. However, a simple test will remove all doubt. If the patient lies down the swelling may be readily reduced. The fingers are now placed at the abdominal ring, and the patient told to rise; hernia will be retained, the swelling of varicocele will return, the vessels filling from below. (If the pressure be sufficiently strong to occlude the arteries as well as the veins the tumor will not reappear.) Varicocele,

complicated by large hydrocele or by hernia, is more difficult of diagnosis.

Treatment.—If the varicocele be small and its symptoms inconsiderable, the patient should be advised as to his sexual hygiene, perhaps instructed to wear a suspensory bandage and treated for neuralgia of the testicle, if this is a feature of his condition. If these measures fail, or if the patient insists upon more radical treatment, surgery must be employed.

The operations for the cure of varicocele are three: injection, subcutaneous ligature, and the open operation; this last including ligature, excision of the veins, and ablation of the scrotum. That operation should be performed which is best calculated to soothe the patient's fears. Subcutaneous ligature gives by far the most rapid recovery.

TUMORS OF THE CORD

Cystic Tumors.—See Hydrocele of the Cord (p. 643).

Solid Tumors.—Solid tumors of the cord are rare. Fibroma, fibro-myoma, and sarcoma, all of the vas deferens, have been observed in isolated instances. Gumma is very rare (Goldenberg).[1] The only tumor of clinical importance is lipoma of the cord. The frequency of lipoma of a hernial sac lends color to the theory that lipoma of the cord is secondary to hernial lipoma. In structure the tumor may be a pure lipoma, a fibro-lipoma, or a myxo-lipoma.

These tumors are usually small and reducible into the inguinal canal, simulating epiplocele, from which they are only differentiated by operation, unless they can be drawn entirely out of the canal. Exceptionally, however, they attain an extraordinary size. Nové-Josserand [2] reports a specimen weighing 6½ kilos, and cites two others weighing respectively 20 and 15 pounds. The larger tumors may be pathologically benign and yet clinically malignant.

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[1] *Jour. of Cut. and Gen.-Urin. Diseases*, 1901, xix, 113.

[2] *Lyon méd.*, 1897, lxxxiv, 237.

CHAPTER LXII

DISEASES OF THE SEMINAL VESICLE

ANATOMY

The seminal vesicle (Fig. 127) is a reservoir connected with the vas deferens. Each vesicle lies to the outer side of its vas, its apex buried in the prostate, where it joins the vas at an acute angle to form the ejaculatory duct. The body of the vesicle is directed obliquely upward and outward, lying along the upper border of the prostate and projecting beyond it laterally. The fundus of the vesicle lies just external to the termination of the ureter in the bladder. Each vesicle is bound close to the bladder and prostate by a dense fascial envelope containing many unstriped muscular fibers. Within this fascia ramify numerous large branches of the prostatic plexus of veins. The relation of the vesicles to the peritoneum is variable. The recto-vesical pouch always dips sufficiently to touch the fundus of each vesicle, and when the bladder is full there is usually a small triangular extraperitoneal space between the vesicles, just above the prostate.

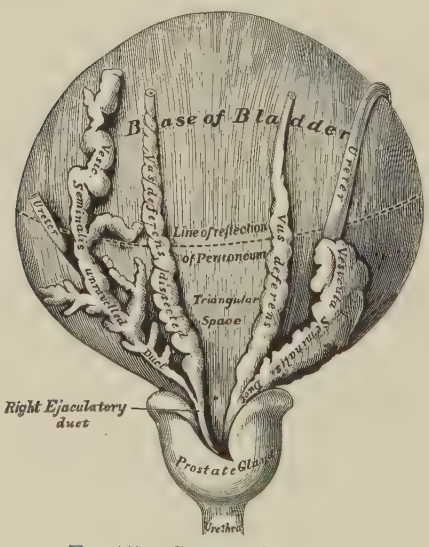

Fig. 127.—Seminal Vesicles.

The vesicle is elliptical in shape, flattened anteroposteriorly. Guelliot [1] gives 49, 18.5, and 10 mm. as its average length, breadth, and thickness. The lumpy surface of the vesicle has been compared to the convolutions of varicose veins or of the intestine. By a tedious and delicate dissection the vesicle may be unraveled. It is a single canal 10 to 15 cm. long. From this canal spring numerous small diverticula,

[1] "Des vésicules séminales," Paris, 1883, p. 27.

one of which, originating near the orifice of the organ, may be almost as long as the vesicle itself. The blind end of the vesicular tube may be doubled back, so that the tube actually terminates near the orifice of the vesicle, and the fundus represents the middle part of the tube.

The tube is quite as irregular within as without. Here and there the orifices of diverticula loophole the tortuous wall, while the mucous membrane is thrown into folds extending in various directions.

The vesicle is made up of three coats: a thin outer fibrous coat, a thick middle layer of circular and longitudinal muscular fibers, and a mucous membrane. The latter contains many elastic fibers. Its epithelium is cylindrical in youth, cuboidal or flattened in old age. The epithelial cells often contain granules of brownish pigment, masses of which are occasionally found in the semen. Guelliot denies the existence of special glands in the vesicle, and affirms that the epithelium is identical throughout the organ. Rehfisch recognizes vesicular glands.

The *arteries* of the vesicle are derived from the inferior vesical and the middle hemorrhoidal. The *veins* join the prostatic and lateral vesical plexus. The *lymphatics* empty into the pelvic ganglia. The *nerves* are derived from the hypogastric plexus of the sympathetic.

The *ejaculatory ducts* begin at the junction of the vas deferens and seminal vesicle. Becoming smaller and of even caliber, these ducts run obliquely forward and upward through the prostate, approaching each other until they nearly touch in the median line. Yet they are quite separate in their openings on the lips of the prostatic utricle. They are closely surrounded by a dense elastic tissue and contain a few straggling muscle fibers derived from the longitudinal muscle of the vesicle.

PHYSIOLOGY

The functions of the vesicle are three:

1. To store the secretion of the testis.
2. To dilute it.
3. To expel it into the prostatic sinus just before ejaculation.

1. Rehfisch,[1] in a detailed study of the comparative anatomy and physiology of the seminal vesicles, showed that in rats, guinea pigs, and some other mammals, the vesicles empty by a separate duct into the urogenital sinus and at no time contain spermatozoa. But he confirmed on man De Graaf's experiment of injecting the vas deferens, showing that the vesicle fills with fluid before the ejaculatory duct is forced open. Hence it is fair to assume that the vesicle, as well as the ampulla of the vas, is a place of storage for the spermatozoa.

2. The *secretion* of the seminal vesicle dilutes the semen and prob-

[1] *Deutsche med. Wochenschr.*, 1896.

ably has some obscure function of stimulating the vitality of the spermatozoa. This secretion is albuminous, alkaline, and odorless. It contains a large proportion of mucin. Besides blood cells, leukocytes, and epithelia, the fluid contains many little hyaline pellets rarely visible to the naked eye. These bodies (sympexions, globulin körner) appear under the microscope as hyaline spheroids showing radiating lines of cleavage. They may contain masses of spermatozoa or pigment granules, and may attain a size sufficient to obstruct the ejaculatory duct.

3. The vesicle becomes distended with fluid by the accumulation of its own secretion and the influx of testicular fluid. Unless there is spermatorrhea, little or none of this fluid escapes, except during the sexual orgasm. This act occurs as follows: after a period of sexual excitement, varying in duration according to the nervous caliber of the individual, the muscular coat of the vesicle and the ampulla of the vas contract peristaltically, driving the fluid into the ejaculatory duct, which, very probably, is relieved of the elastic pressure that usually occludes it by a simultaneous muscular contraction of the prostate. The semen is thus ejaculated into the prostatic sinus, where it mingles with the prostatic secretion. The congested verumontanum blocks the way into the bladder and the prostatic and urethral muscles project the fluid forward by jets. I think the function of the verumontanum in preventing regurgitation is overestimated, for it is a matter of daily experience that the few drops of fluid left in the prostatic urethra at the end of urination are ejaculated by the urethral muscles, though the verumontanum is not at all congested.

Science and experience agree that the seminal vesicles are not emptied by a single orgasm.

ANOMALIES

Anomalies of the seminal vesicles are usually part of some general genital malformation. Guelliot has analyzed and refused to accept the alleged cases of multiple seminal vesicles. When the vesicle is absent the corresponding testicle may yet be present. Extreme dilatation of the vesicles is probably always acquired.

The ejaculatory ducts may empty into one of the ureters instead of on the edge of the prostatic utricle. In a few cases they have been found to continue forward alongside of the urethra the whole length of that canal to the meatus.

WOUNDS OF THE VESICLE

Guelliot recognizes only one case of undoubted accidental wound of the vesicle. The patient had suffered a fracture of the ischium.

Operative wounds of the ejaculatory ducts are very frequent. The patency of the ducts is imperiled by all perineal cystotomies and prostatotomies, including lithotomy, Bottini's operation, and prostatectomy. Two results follow: inflammation (acute vesiculitis and epididymitis) possibly, obstruction probably.

Fistulæ of the spermatic duct have resulted from the old-fashioned lateral lithotomy operations. The resultant spermatic fistula heals kindly unless the parts are cancerous or tubercular.

EXAMINATION AND INFLAMMATION

(See pp. 8, 155.)

TUBERCULOSIS

(See p. 475.)

CYSTS

Prolonged inflammation sometimes causes gradual dilatation of the vesicles until they become two or three times their normal size and even overlap in the median line. Such cysts have only a pathological significance. Occlusion of the ejaculatory duct does not cause the vesicle to dilate.

Several examples of *echinococcus cysts* occurring between rectum and bladder have been attributed, without convincing proof, to the vesicle.

CONCRETIONS AND CALCULI

While it is not unusual to find a number of concretions or small calculi in the vesicles of the aged, they have, as a rule, no clinical symptoms. It is only very rarely that they give rise to spermatic colic.

Symptoms.—*Spermatic colic* was first described, in 1879, by Réliquet. The colic may occur at the moment of ejaculation or during sleep. The pain is very sharp, colicky, in fact, and nauseating. It is centralized about an inch up the rectum, or at the neck of the bladder, and thence radiates up the posterior wall of the pelvis or to the testicles. The pain is caused by the impaction of a concretion or a mass of inspissated semen in the duct. The obstruction may be forced, and a painful and deficient emission ensue after a few moments of colic, or, if it occur without sexual sensations, during the night, it lasts from ten to twenty minutes and then gradually dies away.

Treatment.—The hot rectal douche (p. 201) is an excellent remedy to relieve the pain and to shorten the attack. Many persons who are

subject to mild attacks of nocturnal spermatic colic obtain relief by introducing a finger into the rectum and pressing upon the offending organ.

Relapses are prevented by massage of the vesicle.

MALIGNANT GROWTHS

Guelliot recorded but one authentic case of primary carcinoma of the seminal vesicle. Secondary involvement occurs from the prostate, bladder, or rectum.

CHAPTER LXIII

MALADIES INVOLVING THE GENITAL FUNCTION

IMPOTENCE

Impotence is usually a symptom of some physical morbid condition entailing inability to accomplish the sexual act. It is a complaint not infrequently submitted to the physician; not always frankly and openly as such, but often by implication, as though it should be recognized and inquired about in answer to remote indications which the patient has scantily furnished. Indeed, the physician who would meet the daily wants of his fellow-men in reference to troubles of this sort, must possess an accurate knowledge of the physiology of the sexual function and of its various derangements, and be ready to anticipate the reticence of patients; otherwise he will fail to sound many of the depths of human nature where suffering lurks—which suffering is for the most part preventable or relievable.

Impotence signifies that an individual cannot beget children because he cannot perform the sexual act properly, no matter what the obstacle may be, whether he have spermatozoa or not. The term must be carefully distinguished from sterility, which signifies inability to beget offspring on account of defect in the semen, whether the individual can have sexual intercourse properly or not. Undoubtedly the two are often associated in the same individual, but they may be totally distinct, as the following examples will illustrate. Thus, in the East, there are two methods of making eunuchs: either the penis is removed together with the testicles (and such a eunuch is necessarily both impotent and sterile), or the testicles alone are removed (and such a eunuch, though sterile, may be still potent, and does not bring so high a price as the eunuch who has no penis). It is a well-known fact that both animals and men, from whom the testicles have been removed after puberty, still retain sexual desires, and may have intercourse, with venereal orgasm and ejaculation of prostatic mucus, during a period of many years. A cryptorchid is not impotent, but is very apt to be sterile, and such is the case of many patients after double gonorrheal epididymitis; while, as causes of impotence without sterility, may be mentioned deformities preventing sexual intercourse, though the spermatic fluid is normal,

such as exstrophy of the bladder and extreme incurvation of the penis, with or without hypospadias.

Impotence may be true or false.

True Impotence

This is exceedingly rare in the male. Any one who can perform the sexual act is potent. This act implies two conditions, namely, sufficient erection to make intromission possible and a subsequent seminal ejaculation.

That lack of desire before the act and pleasure during its accomplishment are not absolute essentials to sexual intercourse is exemplified by the two conditions: priapism from cantharides in which there is no desire, and yet intercourse is possible with perfect intromission and ejaculation, and certain diseases of the cord attended by more or less priapism, where intercourse followed by conception may take place, and yet the patient be unconscious at what moment ejaculation occurs.

Conditions Involving True Impotence.—1. Absence of penis. If there are healthy testicles, the patient cannot be called sterile.

2. Minute size of penis may involve impotence. That small size is only relatively a cause of impotence is evident, and that it by no means involves sterility is shown by Orfila, in a case where an action for rape was brought against a man with only a stump of a glans in place of the entire penis, by a woman who was impregnated by him. Orfila decides that impregnation may take place under these circumstances, but only through the consent of the woman, and that consequently rape is impossible. The numerous cases on record where impregnation has taken place without rupture of the hymen show that a deposit of semen within the ostium vaginæ may fertilize an ovum, and such a deposit of semen *might* be accomplished by the smallest possible penis. Intromission and ejaculation might take place, and impotence, though possible, is not essential. The patient is not sterile.

3. Extreme size of the penis is a relative cause of impotence.

4. Extreme epispadias and hypospadias, with or without incurvation, likewise involve impotence, without sterility. Slight hypospadias may, but does not necessarily, involve impotence. The semen is not properly ejaculated into the upper part of the vagina, and impregnation sometimes fails to take place on this account.

5. Large size of the prepuce, or excessively tight and narrow orifice of the same, may involve impotence, as may also any tumors or growths upon or about the penis, elephantiasis, fatty tumor, hydrocele; or neighboring deformity (faulty position of the thigh from ankylosis of hip, excess of abdominal fat, etc.), which may mechanically interfere with copulation without in the least implying sterility.

6. Very tight stricture of the urethra, especially if there be large and multiple fistulæ behind it, involves impotence if the semen does not escape by ejaculation, but dribbles away after erection subsides. A similar cause of impotence exists in a vicious direction of the orifices of the ejaculatory ducts, by which during ejaculation the semen is turned backward into the bladder and escapes afterwards with the urine. According to Grimaud de Caux, such a condition of things may be caused by the action of prostitutes, who, fearing pregnancy, watch for the moment of ejaculation, and then press forcibly upon the urethra of their partner just in front of the prostate, by inserting a finger into his rectum, thus causing the semen to be ejaculated into the bladder. A similar condition has been known to result from prolonged posterior urethritis. When, from these or any other causes, there is no ejaculation, the condition is known as *aspermatism.*

7. Imperfect, irregular, or bent erections, due to inflammation, injury, or tumor of one of the erectile cylinders of the penis, may sometimes prevent intromission and entail impotence.

8. Eunuchs, and those having atrophy of both testicles, are usually impotent, always sterile.

9. Injuries or diseases of the central nervous system may cause impotence by interfering with either erection or ejaculation.

10. Impotence may be *symptomatic*—not to speak of the physiological impotence of childhood and old age—and then is only conditional or temporary, and usually disappears with the removal of its cause.

In symptomatic impotence there is always lack of erection, and often also temporary sterility. Such impotence is always associated with severe acute febrile diseases and with conditions of lowered vitality, whether due to wasting disease, to shock, or to other causes. Long-continued sexual excess, whether by masturbation or otherwise, produces impotence, though this is commonly a false impotence, an inability of the jaded body to keep pace with the lecherous mind. Finally, all drug habits—opium, tobacco, cocain, etc.—tend to produce impotence; and above all may be placed alcoholism. When a man is thoroughly drunk he is impotent; when a steady drinker, his sexual powers are always diminished, sometimes lost. Partial erection, attended by rapid ejaculation, is a common variety of impotence, due usually to sexual overexcitement, and observed in animals as well as in men.

Such a condition is usually a false impotence.

False Impotence

False impotence is an affection which the practical physician is often called upon to treat. True impotence calls for treatment of the physical irregularity, deformity, disease, cachexia, etc., giving rise to it. False

impotence requires treatment of the individual, and not of any disease. The cause is a nervous, or, it may be, a moral one and there is no impotence whatever except in the mind of the patient. Here the surgeon requires all his delicacy, all his sympathy, in order to obtain the confidence of his patient, to overcome his suspicions, and to lead him gently to a cure, which is always possible, if only the patient have faith.

Among the causes of false impotence may be mentioned sexual indifference, either temporary and spontaneous or more or less prolonged, as a result of sudden shock, grief, excessive joy, fright, repugnance, or lack of affection for the individual with whom copulation is attempted. Under the last two circumstances, the patient can sometimes think of another person than the one with whom he is lying, and thus maintain erection and effect ejaculation. The sudden flooding of the vagina with warm mucus will sometimes cause erection to cease at once. Roubaud mentions a curious case where impotence came on with an indigestion, and remained long after its cause had disappeared. He speaks of another man who became impotent on drawing a prize of 30,000 francs in a lottery. The various forms of sexual perversion afford numerous examples of false impotence.

Treatment.—This form of moral impotence requires special attention to all the agencies which may act as causes, and the exercise of tact and sympathy to acquire and retain the patient's confidence, a point of treatment most essential to success. The surrounding hygienic conditions must be made favorable, the advantages derived from change employed, and all indications of deviation from health in any respect appropriately met. It is necessary to arouse the moral sentiment of carnal desire, as well as the power of the organs to respond. The first is attained by favorable relations to the sex—opera, theater, etc. The second, by general dry frictions of the whole body, by massage and flesh-brush, cold bath, sea-bathing, generous diet, and the internal use of tonics: strychnin, ergot, and especially phosphorus, commencing at a fair dose ($\frac{1}{40}$ of a grain), three or four hours before the desired erection, and increasing the dose carefully. Cantharides produces erection without desire; phosphorus directly increases desire. Cold and heat, by the douche, electricity, and local applications of mustard, are sometimes serviceable in recalling erection. In such cases the opportunity of the quack and the charlatan is unlimited. If he can, by whatever preposterous claims, once drive the obsession from the patient's brain, cure is assured. The regular physician cannot debase his self-respect by lies and trickery, but he can and must marshal all the strength of truth and virtue that lies in him to impress upon the patient's mind a respect for himself and his personal decency, as well as an appreciation of the subjective character of his defect.

Mixed Cases—Sexual Neurasthenia

Most of the cases of impotence seen in practice occur in patients whose sexual apparatus and nerves are both debilitated by sexual excess, masturbation, prolonged gonorrhea, or prolonged abuse of alcohol. They are primarily neurotic, but have a physical basis of chronic prostato-vesiculitis or congestion of the verumontanum, and are to be treated both by suggestions as to sexual and general hygiene and by local measures already detailed (p. 241).

Nervous Impotence

In a sense, all false impotence is nervous impotence; but there is a distinct and very common class of sufferers conveniently grouped under this heading. These are mostly young men who, from one cause or another, have got into the habit of acting abnormally in sexual congress. They get either no erection or a very slight one. Emission is absent, or premature, or without any sensation of pleasure. Each case has some peculiarity fondly alluded to by its possessor as proof that he is quite unique. Indeed, the patient's sole desire sometimes seems to be to persuade the physican that he has never before seen a case quite like this one. No possible classification of such cases can be satisfactorily minute, but the following may suffice:

1. The individual's potency is quite normal, but not what the patient thinks it ought to be.

2. The potency has been diminished by some early impression or by excesses.

3. The potency is congenitally slight.

1. The first class may be passed over lightly. Unhappily, there will always be among us a class of men, of splendid physique and infinite endurance, who elect to spend their lives in ignoble homage to Venus. And such men have their followers, their admirers—puny, dyspeptic, rabbit-eyed creatures—whose sole ambition is to flog their bodies on to wondrous feats of venery and bestiality. And since Nature never cast them in this mold, they come crying out because their bellies are not so big as their appetites, instead of thanking God for it.

2. Here is lost manhood! What a picture it recalls of errors of youth, thirty years' experience, electric belts, and what not! Here is the man of fifty, sixty, seventy, whose habits have him in their clutch. "Just once more!" "Days of my boyhood!" Here is where the moral lecture is the most deserved and does the most good. Or it may be the young man with premature ejaculations, weak erections, or nocturnal emissions. He has masturbated more or less, and has nocturnal pollutions. He has usually plentiful evidences of virile power. His

desires may be excessive. He awakes with erections. He can provoke erection, or even emission, at will; but, in the presence of a woman, and when he desires to have sexual intercourse, his organs will not respond; or, if erection comes on, it lacks energy, and is liable to fail at any moment during the act. In short, the patient can do anything he wishes, except rely upon an erection at the critical moment.

This form of impotence is the result of unnatural excitement of the sexual functions. It may come from prolonged ungratified desire or excessive erotic excitement at the moment. It is not infrequently accompanied by involuntary emissions during sleep, and by urethrorrhea, especially after the matutinal erection and defecation. Encouraged by the flaming advertisements of the omnipresent quack, the patient's fevered fancy pictures his condition as one of incurable gleet or wasting spermatorrhea. Probably the entire train of mental association can be traced back to some occasion, perhaps his first attempt at coitus, perhaps his last, when things went wrong through some external circumstance. He was frightened; he tried again, with worse result than before. Immediately his mind reverted to his youthful experiences. He had masturbated either too much or too little. He lays the blame of his condition upon his unusual chastity or his abnormal passions. He broods over his hopeless lot. False promises of a cure often tempt him to a trial, and their failure relegate him, more than ever deeply despondent, to the surgeon.

Treatment.—The treatment is threefold:

1. *The Patient's Sexual Coefficient must be Discovered.*—By the sexual coefficient I mean the amount of sexual power with which he is endowed by Nature. Mankind at large is possessed of the notion that, although men's noses and digestions need not all be cut of the same pattern, it is to be expected that the sexual capacity of everyone should be all-embracing. Thus, while it is no disgrace to be dyspeptic about the stomach, it is to the last degree shameful to be dyspeptic about the genitals. Theoretically, such a distinction is absurd; but practically, no man is willing to brand himself a sexual laggard. In some way, by dint of enumerating emissions, copulations, masturbations, the physician must learn what ideal he can set before the patient. If a man's natural capacity for sexual congress is only once a month, it is hopeless to try and tune him up to three times a night.

2. *The Patient must be Encouraged.*—The first point of encouragement must be to depress him by bidding him look for a protracted and relapsing convalescence. Then he must be made to understand that his sexual possibilities are just so great and no greater; and that, however well he may get, overstepping his allotted bounds will call down swift retribution upon him. Finally, he must really be encouraged to feel that his malady is a functional disorder, a dyspepsia, which, like other

dyspepsias, is curable, but only at the cost of a prolonged fast. He must abstain from coitus, from masturbation, from lewd companions, from obscene thoughts and things. The more thoroughly he abstains, the more certain his cure. Usually he will try to adopt halfway measures, caring more for his " pot of ale " than for body and soul together. But such a course may not be countenanced. The ideal of absolute purity must be forever set before him and, as it were, hammered into him.

3. *He must be Assisted Physically.*—When possible, an entire change of scene presents the best opportunity for a man to get out of his old rut. Nothing could be better than a hunting or fishing trip. But if this is impossible, tonics may be given him, and sounds, nitrate-of-silver applications, rectal douches, according to the choice of the physician. To some hyperesthetic individuals, massage of the vesicles is so nearly a suggestion of the sexual act that I fear it is quite as likely to do harm as good. If a strong moral influence, as that of father, brother, or priest, can be brought to bear, so much the better.

But all these measures are frankly palliative. When a man has once got into the habit of concentrating his whole mind upon his sexual organs, it is not to be expected that he should be entirely diverted to higher things. Chastity all can aim at, but celibacy is beyond the reach, beyond even the understanding, of the many. Hence, the proper cure for such a man, if he can be got into such a condition that he has an erection ever so rarely, is to instruct him in sexual physiology and hygiene, to acquire his confidence by sympathy, and to get him married, with the advice to attempt no intercourse, to be entirely frank and honest with his wife (who will more than equal him in timidity and ignorance), and, awaiting some morning when awaking with a vigorous erection, to accomplish coitus promptly without delay, as a matter of imperious duty. The act once accomplished, the spell is broken. He knows he is a man and his confidence in himself returns.

STERILITY

Sterility is an inability to beget children on account of absence or imperfection of the semen. In many cases there is impotence as well. All eunuchs are sterile. When both testicles are degenerated or destroyed by disease or atrophy sterility results.

The spermatic fluid, though ejaculated, may contain no spermatozoa (*azoöspermia*). This condition results from any obstruction to the formation of spermatozoa, any obstruction to their passage from the testicles to the meatus, or any inflammation in the seminal canals of sufficient intensity to destroy the spermatozoa. Without enumerating all the possible causes of azoöspermia, three may be especially designated:

1. Obliteration of both epididymes or both vasa deferentia by (gonorrheal) inflammation.

2. Debilitating diseases and, above all, alcoholism. Simmonds [1] estimates that 61 per cent of alcoholics are sterile.

3. Inflammation of the prostate or vesicles. If the inflammation is severe the spermatozoa may be killed *in transitu;* but only a mild catarrh is required so to alter the quality of these secretions as to deprive them of the property of nourishing the spermatozoa.

Aspermatism, absence of ejaculation, is another less frequent form of sterility. It may be idiopathic or due to operation upon the bladder and prostate. Such cases are not often encountered nowadays, but in former times, perineal lithotomy and Lallemand's porte-caustique made many a man sterile. Grimaux de Caux remarked of the latter that it made more eunuchs than did the demands of all the harems of the East.

Treatment.—Sterility from obstruction may be curable by Martin's operation. Sterility from inflammation or from systemic disease is usually as curable as its cause.

SELF-ABUSE

Self-abuse is the production upon one's self of the venereal orgasm. The term masturbation signifies that an orgasm is produced by means of friction with the hand. Masturbation is not a malady. It does not necessarily produce disease unless carried to excess. Its practice is not confined to man. Monkeys are often masturbators; bears have the same habit; goats, making use of the mouth, indulge in it; turkeys sometimes practice it. In the human being it is practiced by both sexes at all ages, females being much less addicted to it than males. The majority of women have very little passion, and suffer the first approaches of a lover or husband largely as a matter of complaisance. Undoubtedly there are numerous exceptions to this rule, but still a rule it is that the female, naturally modest, retiring, refined, learns what passion is only as the result of experience. With the male it is different. His passion is natural. He often has erections while yet a child, and has sexual yearnings long before puberty. Rarely does a boy escape initiation into forbidden pleasures by his schoolfellows or his elders, and, though he escapes these, he is still very likely, when handling himself during erection, to find the sensation agreeable, and to go on, really ignorant of what he is doing, until he has become a confirmed masturbator. Male babies are sometimes handled by their nurses to keep them quiet, a practice which is certain to beget the habit even in the earliest years of life. Stone in the bladder, irritation of the prepuce from retained

[1] *Deutsch. Archiv f. klin. Med.*, 1898, lxi, 412.

smegma, ascarides, etc., lead a child to handle himself, and end in masturbation, if long continued; indeed, there are so many causes, natural and unnatural, why a boy should masturbate that few escape. But the most common cause is instruction received from other boys at school.

It may be safely assumed that a large proportion of mankind have masturbated more or less at some period in their lives, and it is equally safe to assert that at least 90 per cent of such masturbators are not physically injured by the habit. If carried to excess, sexual indulgence in the natural way will produce evil effects, yet sexual intercourse is not only harmless, but even beneficial in moderation, as it can be only in the married state. It is not the loss of seminal fluid which is of the first importance in producing disease from sexual excess, but the nervous shock of the oft-repeated orgasm. Babies and young children lose no seminal fluid, women have none to lose, yet, in all of these, evil results follow excess as certainly as they do in the male after puberty. It is probable that any succession of nervous shocks as sharp and decisive as the sexual orgasm, even although purely intellectual, such as joy or fear, would shatter the vitality and nervous tone of an individual as much as masturbation.

Such writers as Lallemand, Acton, Belliol, certainly make too much of the solitary vice, while quacks find here the largest and most lucrative field for their nostrums. These men scatter their books and circulars broadcast over the land, and often, under alluring titles, thrust them within the eager grasp of the young, the inexperienced, the hypochondriacal, the nervous, overworked, unmarried youth, whose sexual needs, stimulated by his impure thoughts, find no adequate relief. Their tenets find ample faith and ready acceptance in the ingenuous mind, and errors are implanted which years of sober after-thought and experience, aided by the physician's careful and conscientious advice, are scarcely able to eradicate. Self-abuse is not confined to youth; middle and old age are not free from it. The numerous foreign bodies found in the urethra and bladder attest the tendency that men of all ages have to meddle with their genitals.

The use of tobacco, alcohol, and, it might be added, tea, is as widespread as the habit of masturbation; and each of these, or certainly the first two habits, probably inflicts as much injury upon the human race as does the secret vice. Yet who would affirm that every man who smoked would have headache, dyspepsia, heartburn, neuralgia, intermitting pulse, or would become thin, depressed, nervous, sleepless —all of which effects may be produced by an excess of tobacco; or that another who drank liquor would necessarily have delirium tremens, cirrhosis of the liver and kidney, and die with ascites and Bright's disease? As with whisky and tobacco, so it is with masturbation carried to excess. Masturbation is capable of producing the most serious

results, among which idiocy, insanity, epilepsy, dementia, physical prostration, hypochondria, impotence, and sterility are prominent, but these are extremely rare, and even in these rare cases it will often be found that some other cause, such as congenital degeneracy, or alcoholism has acted in conjunction with the masturbation. Hence it is evident that, while the intelligent physician must recognize the physical evils masturbation may produce, he should boldly oppose himself to that sickly sentimentality which shrouds in mystery one of the failings of our physical nature because it involves the sexual function, and should try to face the subject honestly and to handle it as a scientific problem.

The majority of mankind who indulge in masturbation do so just before and after puberty. At first most of them are ignorant that they are harming themselves, but they soon find it out by one means or another, and then sooner or later give it up. The longer and the more frequently they yield to the vicious habit the stronger does its hold become, so that in case they escape the mental and physical disorders to which excessive venery in extreme cases may give rise, still they may pay the penalty of excess by some diminution of vigor in after-life, by upsetting their sexual hygiene, and by establishing sexual necessities which they find it difficult to satisfy; and, finally, they may continue on through life victims to a perverted sexual sense, shunning women, from whom they aver that they derive no pleasure, totally wrecked as to their *morale*, hypochondriacal, and suffering from all sorts of functional distress, physical and intellectual, real and fancied.

The chief reason why so much is said of venereal excess by masturbation, and so little of sexual excess in the natural way is, that the former is so much more common, and not that the act itself is physically more harmful. The solitary vice, as it is aptly styled, may be practiced on all occasions, even in company, by the hand in the pocket, or by friction against some prominent object. In schools, not infrequently, boys practice it upon one another; but, generally, masturbation is performed in bed and in solitary places where there is no possibility of disturbance. Hence, in some cases, the frequency of its performance is very great and the effects of often-repeated nervous shock more pronounced. On the other hand, sexual intercourse requires the consent of two individuals and opportunities which are comparatively hard to find. Moreover, a man's moral sense will often keep him from committing excess with a woman, when nothing will restrain him while alone. In married life, excess is the exception; sexual hygiene is more apt to be correct, man is in his natural condition, other emotions enter largely into his daily life, and it is rare that a man happily married complains of any disorder of the genito-urinary system, except those of a purely physical nature. On the other hand, the old rounder, who flatters himself upon the number of women he has

ruined, but lays the blame upon Dame Nature, is usually a masturbator and, not infrequently, a pervert.

Symptoms.—A young child who has been taught to masturbate will be seen constantly at work at his genitals, and observed to have erections with unnatural frequency. No further signs are needed. Such children are fretful, peevish, thin, nervous, excitable, sleep badly, and have a haggard look.

Boys who masturbate to excess usually have a long prepuce (they may have none, for Jews masturbate); they get a sallow look, have a sheepish, hangdog expression; their eyes are deep set, they incline to melancholy broodings, to staying apart and reading rather than to joining their companions at play. They become absent-minded, and their memory seems defective. Their palms are apt to be cold and moist. They lose the innocent frankness of youth.

The young man is overshy, unambitious, he shrinks from a steady gaze, blushes readily, and seems to be conscious of having done something unmanly.

Adult masturbators often show no sign of the habit, though they are apt to be cowardly, mean-spirited, poor specimens of humanity. But it is rare for adults to practice masturbation to great excess, and, if they suffer from any of the supposed evil consequences of the habit, it is either on account of excess in earlier life, of imperfect sexual hygiene, or of irregularly gratified sexual desire. Their symptoms assume a multiplicity of expression, and are generally hypochondriacal, and manifestly not entirely dependent upon masturbation; for the same symptoms may be relieved by marriage and are very common in patients who do not masturbate. As to atrophy of the genitals, varicocele, etc., these are not due to masturbation. Masturbation is a symptom, rather than a cause, of insanity.

Castration has been employed in the vain hope of checking the vice. It is quite useless.

The foregoing remarks are not intended to palliate in the least degree the baseness of the practice of self-abuse, or to deny that lack of physical and sexual vigor, spermatorrhea, neuralgia of the urethra, etc., may be caused by its excessive indulgence; but they are intended to combat the prevalent idea that very few men indulge in the secret vice, and that all who do so suffer; and they are also intended to advance the proposition that in the vast majority of instances masturbation does little harm to the individual, except in regard to his *morale*. It unmans him, makes him untrue to himself, and cowardly; and most sensible boys find this out before a great while, and give up the practice, which they feel to be sapping their manhood and self-esteem.

Treatment.—It is infinitely better that a boy should never masturbate if he can be prevented. Prophylactic instruction may save him.

In the case of babies who do not do well, nurses should be watched and discharged if they are found handling the child. If the infant has already acquired the habit, his hands must be tied when he sleeps, and at all other times he must be watched until he grows out of the habit. Boys should always be made to sleep alone, never allowed to consort secretly with any other one boy. All close intimacies between boys of different ages should be broken up, and, on the appearance of any of the signs of masturbation, a close watch should be maintained.

In most cases it is not good policy to ask a boy if he fingers his privates. He will be pretty sure to say no, and then to tell other lies to substantiate the first. To assume the fact after a careful study of the case is the safest course, and the boy, thrown off his guard by the statement that he does masturbate, will rarely deny it, or will do so in such a lame manner or with such overpositiveness as to convict himself. Finally, when the patient has confessed his folly, it is not wise to terrify him out of his habit by brilliant and exaggerated statements of the possible misery he may bring upon himself if he does not desist. This is appealing to a base motive, and, although sometimes successful, it is often inadequate to the proposed end, for a healthy boy cannot realize what it means to be sick; he cannot understand it, and consequently is not afraid of it. The method of treatment that is most effective, but requires the most force to carry out, is to elevate the boy out of his bad habit, to shame him, to make a man of him, to reason with him, and to talk to him honestly and openly, without reserve or mysticism; to sympathize with him, not to wound him; to study him and treat him morally. This course will succeed with the greatest number, provided only sufficient time and attention be given to it.

When a man comes complaining of the results of masturbation, an attentive study of the symptoms will prove his disease to be hypochondria, and his malady ungratified sexual desire, often with congestion of the verumontanum. His training should consist in encouragement and continence, with absolute purity of thought, and subsequently marriage, to regulate his sexual hygiene. After marriage we hear no further complaint from these cases, always provided there is really nothing more than functional derangement at the bottom of the patient's complaint, as is the case in the vast majority of instances.

As for medicines, they are of little or no value; camphor, bromid of potassium, or lupulin may be given as placebos, but it is doubtful if they have any efficacy. Cold sponge-baths, outdoor sports, physical fatigue, sleeping in a cool room on a hard bed with a light covering, are all useful; eating lightly at night, not retiring until very sleepy and rising immediately on waking in the morning, are powerful assistants in breaking up the habit; but all will be of no avail unless the

morale of the patient be elevated, unless he keep his thoughts pure, and desire, for the manliness of it alone, to be rid of his bad habits.

POLLUTION

Pollution is a term applied to involuntary emissions of semen in ejaculation, attended by a more or less marked venereal orgasm. Pollutions are nocturnal or diurnal.

Nocturnal Pollutions

Nocturnal pollutions are exceedingly common. They usually accompany an erotic dream, and the patient wakes just as the ejaculation is occurring. Sometimes, when sleep is profound, the patient does not wake, or, if he does, he forgets his dreams, so that the sensation of pleasure accompanying ejaculation is faint and forgotten. Occasional nocturnal emissions are entirely natural and by no means a sign of disease. Their frequency compatible with health varies with the purity of mind and the sexual vigor of the patient. A man who is happily married rarely has nocturnal emissions while living with his wife, but, if he leaves her for several weeks, it is natural that there should be a formation and collection of semen which, distending the seminal vesicles, excites erotic fancies and, in the relaxed condition between sleeping and waking, escapes at the conclusion of a dream. Any man suffering from ungratified sexual desire is normally in a condition demanding relief for his overdistended seminal vesicles and, if that relief be not afforded in some way, it comes spontaneously during sleep. This is all the more certain to be the case if he has established a habit of rapid formation of semen by excessive sexual intercourse, or by habitual masturbation; and especially if, when natural or unnatural gratification is given up, lascivious thoughts are indulged in and impure associations continued. Occasionally nocturnal emissions may be overfrequent, and indicate a condition of irritation in the deep urethra which requires treatment.

Treatment.—When emissions do not exceed two a week they should be disregarded, and attempts made only to purify the patient's thoughts, to elevate his tone, and if possible to get him happily married. When they occur as frequently as once or several times a night for a considerable time, certain special attempts to correct the habit are advisable, besides the employment of all known tonic and hygienic means and the measures detailed above. The patient should exercise and develop his muscular system. He should endeavor to tire himself out by physical work so as to sleep soundly. Locally, cold baths and cold douches are useful. He should sleep on a hard bed, lightly covered. The

stomach should not be full on retiring. Most patients have involuntary emissions toward morning, and waking, find themselves lying on their backs. This position, with the bladder somewhat distended, tends to beget erection, and, by avoiding it, pollution may be escaped. This is accomplished by tying a towel round the waist on retiring, with a hard knot in the back of the spine. When the patient lies upon this knot it awakens him. The local measures to be employed have been described (p. 241).

From time to time different mechanical devices appear for treating pollution, their object being either to prevent the patient from handling himself during sleep or to awaken him before emission when he gets an erection. I believe them valueless and as likely to do harm as good, by keeping the patient's mind concentrated upon his malady and leading him to attach too much importance to the physical act of emission.

Diurnal Pollution

Diurnal pollution is rare. Some impressionable patients acquire so intense a prostatic irritability from venereal excess that the sight or thought of certain women or the lightest friction upon the glans penis will produce ejaculation. Such injuries to the spine as are caused by the garrote, the guillotine, and the gallows commonly cause ejaculation; and sexual perverts find in shoes, hats, odors, and various abominations sufficient cause for pollution.

PRIAPISM

Priapism is more or less continuous erection without desire. With some forms of priapism intercourse with ejaculation may take place. The connection between injuries of the cerebellum and spinal cord and erection has long been observed. Roubaud quotes Serres in stating that out of 11 cases of cerebellar hemorrhage erection of the penis was noted 6 times. Death by hanging is often accompanied by partial erection. After injuries to the spine, and in some diseases of the cord producing paraplegia, erections are often absent, returning as the paralysis improves. On the other hand, certain diseases and injuries of the cord are attended by priapism, disappearing as the paraplegia gets well.

The effect of large doses of cantharides in producing erection without desire is well known.

Prolonged mental exertion, overanxiety, and other causes capable of reducing the tone of the nervous system are sometimes attended by priapism, which also occurs in the early stages of prostatic hypertrophy and as an evidence of leukemia.

Priapism in children is often due to stone in the bladder, tight prepuce, worms in the rectum, etc. Extreme cases are on record where priapism has terminated in gangrene of the penis.

Treatment.—Priapism usually gets well under hygienic and symptomatic treatment, beyond which no special measures can be suggested, except irritating the lower part of the spine, blistering the perineum, possibly the use of electricity, and ergot, or bromid of potassium tentatively. Iodid of potassium has been successfully used.

CHAPTER LXIV

DISEASES OF THE PENIS—ANATOMY—ANOMALIES—INJURIES—INFLAMMATIONS

ANATOMY

The penis is a genital organ. Its urinary function is purely secondary. It is conformed anatomically to subserve the genital function. In the adult it measures, when at rest, from the root of the scrotum to the meatus urinarius, from 6 to 10 cm. ($2\frac{1}{2}$ to 4 inches); when erect, from 12 to 17 cm. (5 to 7 inches). It consists essentially of three segments—the two corpora cavernosa, lying together like the barrels of a gun, and the corpus spongiosum, like the ramrod, beneath them (Fig. 128), the whole surrounded by integument.

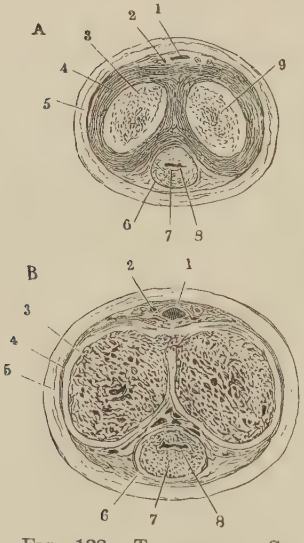

Fig. 128.—Transverse Sections of Penis (Cruveilhier). *A*, flaccid. *B*, in erection. 1, 2, dorsal vein and artery; 3, corpora cavernosa; 4, tunica albuginea; 5, integument; 6, tunica albuginea of corpus spongiosum; 7, erectile tissue; 8, urethra.

The Corpora Cavernosa. — The corpora cavernosa arise on each side from the tuberosities and ascending rami of the ischium. They come together under the symphysis pubis, and continue side by side, forming the main bulk of the penis. They terminate anteriorly in a conical extremity, over which the glans penis (the terminal expansion of the corpus spongiosum) fits like a cap. There is no vascular communication between the corpora cavernosa and the glans penis, or the corpus spongiosum.

The corpora cavernosa are surrounded by fibrous sheaths which are so dense and strong that they will support the weight of the cadaver.[1] These sheaths are, however, plentifully supplied with elastic fibers, to allow for the variable size of the organ. The anterior portion

[1] Cruveilhier, "Traité d'anatomie descriptive," Paris, 1865, ii, I, 386.

of the partition between the corpora cavernosa is perforated by numerous apertures, to insure thorough and symmetrical erection. The tissue proper of the corpora cavernosa is known as spongy or erectile. During erection the areolæ of this tissue become distended with blood, as shown in Fig. 128.

The Corpus Spongiosum.—The corpus spongiosum urethræ is also composed of erectile tissue. It surrounds all that portion of the urethra lying in front of the triangular ligament, anteriorly forming the glans penis, which caps the conical extremity of the corpora cavernosa, posteriorly terminating in the bulb, which lies just in front of the triangular ligament in the angle of the converging corpora cavernosa.

The Glans.—The glans penis (Fig. 20) is covered by a semi-mucous membrane endowed with peculiar sensibility, especially around the raised posterior border—the corona glandis. The epithelium covering the glans is fine, the papillæ minute (Home), the sebaceous glands (of Tyson) large and numerous, and most plentiful about the frenum. These glands secrete the white material (smegma) that collects behind the corona. The function of the glans penis is to furnish a soft-skinned expansion for the distribution of the terminal filaments of the nerves of sexual sensibility.

Muscular Action.—One important function of the corpus spongiosum is acquired through its bulb—namely, that of assisting in the expulsion of the last drops of urine or semen from the urethra. The prostate, the levator ani, and the deep urethral muscles—especially the compressor urethræ—contract upon the fluid remaining in the canal after micturition in that spasmodic effort called by the French *coup de piston*. This forces the last few drops beyond the bulb of the urethra. Now the fibers of the accelerator urinæ surrounding the bulb and adjacent portions of the corpus cavernosum contract, and forcibly drive the blood contained in the areolæ of the bulb forward along the corpus spongiosum, forcibly distending that body, and thus bringing the walls of the urethra more closely into contact in a progressive wave. This helps to explain why in cases of organic stricture the last few drops of urine do not escape promptly but dribble away; for the scar tissue which constitutes stricture obliterates the areolæ of the erectile tissue and thus obstructs the free passage of the wave of blood along the corpus spongiosum.

Fascia.—The three erectile bodies which have been briefly described are surrounded by the fascial sheath of the penis. This fascia arises from the symphysis pubis by a triangular bundle of fibers, the suspensory ligament of the penis, and from the pubic rami at the attachment of the anterior layer of the triangular ligament. Thence it runs forward, surrounding the corpora cavernosa and the corpus

spongiosum in two separate compartments. The lower plane of this fascia is in its posterior part identical with the deep layer of the perineal fascia. The cavity of Buck's fascia is bounded anteriorly by the base of the glans penis and posteriorly by the triangular ligament. Hence periurethral cellulitis and extravasation are habitually confined within these limits for an indefinite time, unless at the root of the penis where the fascia blends with that covering the pubes, and leaves a loophole of escape into the areolar tissue of the abdominal wall.

Vessels.—The lymphatics and veins of the penis run along the dorsum, and receive in their course branches from the corpus spongiosum. The lymphatics lead mainly to glands lying along and above Poupart's ligament on each side. The arteries arise from the internal pudics.

Connective Tissue.—The connective tissue between the skin and Buck's fascia is very loose and elastic, and, like that of the eyelids, does not contain fat.

Skin.—The skin of the penis, except that it tends to become pigmented after puberty, does not differ essentially from ordinary integument. Over the glans penis it folds back upon itself, forming a nonadherent sheath for the glans (the prepuce), evidently intended to preserve the delicate sensibility of this portion of the member.

The Prepuce.—The prepuce is composed of two layers, a cutaneous (external) and a more delicate semimucous (internal). The point of junction of these two is called the orifice of the prepuce. Between these layers is a very loose and elastic connective tissue, without fat, which permits the two surfaces to be entirely separated from each other, and the prepuce effaced, by drawing back the integument of the penis until the glans is entirely uncovered. The mucous layer of the prepuce is supplied with glands (of Tyson). It is much less elastic than the cutaneous layer.

The prepuce is attached to the lower angle of the meatus urinarius by a triangular fold of mucous membrane called the frenum preputii—analogous to the frenum linguæ. The frenum contains a small artery which when cut or torn bleeds freely.

ANOMALIES OF THE PENIS

Deformities of the penis are constituted by abnormalities in some of its constituent parts. The most common examples will be mentioned in connection with these parts. As anomalies of the penis as a whole, two conditions demand special notice—double penis and absence of the organ. Anomalies in size occur, as when the penis is 9 or 10 inches long when at rest, or only a couple of inches long when erect; but these variations require no comment.

Double Penis.—Double penis is excessively rare. It is analogous to double uterus and vagina in the female, but by no means so common. Undoubtedly it is not so rare as the records of surgery imply, for the existence of this deformity naturally leads the patient to shun observation; and, as the defect is not necessarily accompanied by any injurious symptoms, he does not voluntarily subject himself to the inspection of a physician. Hence the cases usually reported, such as those of Hart,[1] and Gorre,[2] accompany grosser malformations of fetal inclusion. The case reported in the first edition of this treatise [3] is a notable exception. Similar ones are reported by Drs. Alan P. Smith,[4] J. Lorthior,[5] and Carl Beck.[6]

Smith's patient had a stone in one of his bladders, was cut and cured. He could urinate from either bladder at will.

Torsion of the Penis.—With epispadias and hypospadias the penis may be more or less completely twisted upon itself. Jacobson [7] has collected a number of cases. In Caddy's [8] case the torsion was unaccompanied by any urethral defect.

Absence of Penis.—The various amputations of the penis, surgical, traumatic, or gangrenous, do not concern us here. The congenital deformity is a rare one, and usually unaccompanied by any faulty development of the testicles or of other parts of the body. The scrotum, however, is usually small and may be bifid. In either case the external genitals closely resemble those of a woman. In fact this is male pseudo-hermaphroditism. Harris [9] emphasizes what he claims is an infallible sign of the sex of such a person if an adult. If a female, the upper border of the pubic hair forms a clearly cut transverse line across the hypogastrium, while the hair of the male rises up in a curved line toward the umbilicus.

The urethra opens in the median perineal raphe or on the anterior rectal wall. In the latter case there is danger of ascending infection, as actually occurred in Matthews's [10] case. This patient, in spite of his manifest impotence, was a married man. Harris collected 6 cases, including 1 of his own, omitting 2, Révolat's [11] and Wright's.[12] More recently Preston [13] has reported a case.

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[1] *Lancet*, 1866, i, 71.

[2] *Compt. rend. de l'Acad. des Sciences*, 1844.

[3] Case I, Van Buren and Keyes.

[4] *Trans. Med. and Chir., Faculty of Maryland*, April, 1878.

[5] *Centralbl. f. d. Krankh. d. Harn. u. Sex.-Org.*, 1901, xii, 381.

[6] *Med. News*, 1901, lxxix, 451.

[7] "Diseases of the Male Organs of Generation," 1892, p. 612.

[8] *Lancet*, 1894, ii, 634.

[9] *Phila. Med. Jour.*, 1898, i, 71.

[10] *Amer. Practitioner and News*, 1894, xvii, 27.

[11] *J. de Sédillot*, xxvii, 370; Demarquay, *Maladies chir. du pénis*, Paris, 1879, p. 538.

[12] Ashby and Wright, "Diseases of Children," p. 531.

[13] *Med. Record*, 1898, liv, 315.

Apparent Absence of Penis.—Congenital dislocation or apparent absence of the penis exists when the penis, lacking its proper sheath of skin, lies buried beneath the integument of the abdomen, thigh, or scrotum. Boutelier [1] reports such a case. Under the skin above the scrotum a movable body was felt, liberated by incision, and discovered to be the penis. Another case, reported by J. Murphy,[2] would seem to be rather a penile adhesion to the hypogastrium, for the child could urinate through a hole in the lower part of the abdomen. The *treatment* of such a condition implies the immediate liberation of the incarcerated member to avoid urinary infiltration. In this emergency any method of covering the denuded penis with skin may be employed, the simpler the better, leaving until later years the task of affording a more satisfactory envelope to the organ.

Congenital incurvation of the penis and scrotal concealment of that organ occur as phenomena accessory to hypospadias, and will be considered as such.

Hermaphroditism.—Accepting Klebs's definition of true hermaphroditism—viz., the existence of dissimilar genital glands (i. e., at least one testis and one ovary) in one individual—there is still some doubt whether any such individual has existed. Dr. Blacker and Mr. Lawrence [3] maintain the positive side of the question, and find in the literature foundation for their belief. However this may be, we may rest assured that in no case has it been recorded that the person was, functionally, both male and female, producing both spermatozoa and ova. On the contrary, as a general rule they are sexually neuter. These true hermaphrodites resemble clinically the pseudo-hermaphrodites—persons whose sex can with difficulty be determined—and they sometimes come to the surgeon asking him to make them distinctively male or female, whichever he may deem more appropriate. In deciding such a question, if the external genitals are quite indeterminate—as they often are—the chief characteristics to be considered are the shape of skeleton, the disposition of the superficial fat, the growth of hair, facial and pubic (see above), the voice and the shape of the larynx, and, finally, the sexual sentiments of the individual. The process of "making a man of him" or "a woman of her" may be long and tedious, but may prove successful, as in a case reported by Gruber,[4] in which amputation of the hypertrophied clitoris, posterior colpotomy to enlarge the rudimentary vagina, and electric epilation of the facial hair sufficed to establish the external female characteristics.

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[1] *Union méd. de la Seine inférr.*, 1875, xi, 27.

[2] *Brit. Med. Jour.*, 1885, ii, 62.

[3] *Trans. Obstet. Soc.*, Lond., 1896, xxxviii, 265.

[4] *Centralbl. f. d. ges. Therap.*, Wien, 1897, xv, 385.

ACCIDENTS TO THE PENIS AS A WHOLE

Wounds.—The penis is liable to be wounded by accident or by design. In the latter case insanity, or the melancholy depression produced by masturbation, induces the patient to mutilate himself; or the injury may be inflicted by a jealous woman.

Superficial cuts are unimportant, but wounds extending through the sheaths of the corpora cavernosa may give rise to troublesome, possibly fatal, hemorrhage, while the cicatrices left after healing may distort the penis and render erection imperfect and painful.

In a case of traumatic aneurysm due to a knife-cut, Malgaigne [1] tied the dorsal artery.

Treatment.—Cleanse the wound. If a large artery be spurting, tie it, but disregard the oozing points. Endeavor to obtain primary union by immediate suture. Introduce the sutures just deep enough to hold the fibrous sheath. Employ moderate pressure in dressing. Erections, which are sure to occur, since the local inflammation induces a flux of blood, retard healing.

Even in cases seemingly desperate, where the penis has been almost wholly severed from the body, an attempt should be made to save it. A remarkable success in a case of this sort, where the whole penis was severed except a portion of one corpus cavernosum, is related by Artaud.[2] Erectile power is not regained after such a recovery.

Contusions.—The escape of blood under the skin after superficial contusions of the penis is often excessive, on account of the laxity of the connective tissue and the large size of the superficial veins. Deeper contusions give rise to localized swelling from circumscribed effusion of blood. This swelling fluctuates and deforms the penis more or less, sometimes causing it to deviate when erect. If the contusion be severe enough, inflammation of the corpora cavernosa results, which may end in suppuration or gangrene. Severe contusions involving the urethra may lead to infiltration of urine and urethral fistula with loss of substance.

The introduction of the penis into a ring is a classical accident. The penis swells, the patient is ashamed to seek relief, and serious inflammatory mischief—even gangrene, urinary fistula—may ensue. Guillot in such a case conceived the happy idea of dissolving the ring, which was of gold, in a bath of mercury. Demarquay [3] narrates many curious instances of a similar character.

Excessive subcutaneous hemorrhage may be controlled by the application of cold and pressure, with due regard for the possibility of

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[1] *Revue Medico-Chir. de Paris*, 1850, p. 52. [2] *Bull. de la Soc. de Chir.*, vii, p. 451.
[3] "Maladies chir. du pénis," Paris, 1877.

sloughing if the treatment is overdone. Later, simple pressure to promote absorption will suffice, or the clots may be evacuated through an incision made under local anesthesia with the usual aseptic precautions. If gangrene occur, the penis should be kept absolutely dry and clean by applying a mildly antiseptic powder and a gauze dressing. The gangrenous tissue may be removed piecemeal, until it has all been cleared away, after which the gaps may be filled in by skin-grafting or by a plastic operation.

(For injuries involving the urethra, refer to diseases of that canal.)

Fracture of the Penis.—When the fibrous sheaths of the corpora cavernosa are ruptured by sudden forcible flexion of the erect penis, a sort of fracture of the member is produced, with extensive extravasation of blood, sometimes amounting to traumatic aneurysm. Pain, generally present, is sometimes replaced by a sensation of heat, distention, and weight. Valentine Mott [1] reported two interesting cases of this accident, where the only treatment employed was rest and cold locally applied. Both recovered with a useful organ and no deformity. Demarquay has cited many others.

Treatment.—A stout woven catheter, strong enough to resist lateral compression, is passed into the bladder to insure the patulousness of the urethra. Upon this the penis may be bandaged and cold applied. If the pressure proves unbearable or if gangrene, extravasation, or cellulitis threaten, the clots must be evacuated and the bleeding checked through an incision made with all aseptic precautions.

After recovery an indurated spot may remain permanently to mark the site of the injury, perhaps making erection imperfect or painful and interfering with sexual intercourse.

Fracture of Corpus Spongiosum.—Fracture of the corpus spongiosum is generally occasioned by "breaking the chordee" in gonorrhea. The inflamed tissue gives way, yielding urethral hemorrhage as an immediate and traumatic stricture as a remote result.

The healthy corpus spongiosum may be fractured during erection. Dittel [2] gives one such case. My father has seen another.[3]

Dislocation of the Penis.—When the integument of the penis is violently dragged upon, as, for instance, when the clothes are caught and torn away upon a revolving wheel, the entire penis may be shot out of its investing cutaneous sheath and lodged in the scrotum, the perineum, the groin, or under the integument of the abdomen. In such cases, the semimucous membrane of the prepuce gives way either at the preputial orifice or just behind the corona. A number of instances of

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[1] *Trans. of the N. Y. Acad. of Med.*, vol. i, Part I, 1851, p. 99.

[2] *Wien. med. Blätter*, 1885, Nr. 2.

[3] Van Buren and Keyes, 1st ed., p. 7.

this curious luxation have been recorded.[1] The penile injury is usually not discovered until retention of urine or the passage of urine by some opening at a distance from the preputial orifice directs attention to the contused genitals, when the penis is found to be only a sheath of integument containing clotted blood. Sometimes it has been difficult to find the penis at all; but an intelligent search will always reveal it, and then the surgeon's obvious duty is to replace it in its sheath, incising the integument about its root as far as may be necessary to attain the desired result.

In dislocation, the urethra is often ruptured low down, and, after the organ has been replaced in its sheath, perineal section without a guide may be called for.

In one case, a six-year-old child, Nélaton reduced a dislocated penis through the preputial orifice by means of an aneurysm needle, assisting its hook action by external manipulation.

CUTANEOUS AND MUCO-CUTANEOUS AFFECTIONS OF THE PENIS

Many common skin diseases involve the skin of the penis as well as other integumentary parts. As a rule, they present no special characteristics and require no comment here. *Venereal sores,* true chancre and chancroid, are common, as also are soft venereal warts. These receive mention elsewhere. A rare disease is *scabies,* which, causing ulcerated spots and enlarged inguinal glands, may be mistaken for chancroid, from which it may be differentiated by the "burrows" and the accompanying interdigital lesions. Jacobson reports a case of epitheliomatous degeneration occurring in a patch of *eczema* which covered the root of the penis and the inner third of the groin. Hutchinson[2] circumcised a boy for *lupus* of the prepuce and obtained a perfect result. Rake, of Trinidad,[3] has performed circumcision on 16 *lepers,* and, even though the incision actually traversed a leprous patch, it always healed kindly.

Herpes Progenitalis.—This affection consists in the development of clusters of vesicles upon reddened patches on the mucous covering of the glans, or on either layer of the prepuce, or on other portions of the neighboring skin, attended by a slight sensation of heat and tingling. When occurring on the cuticular layer, herpes runs its course as it does elsewhere on the body, but when vesicles develop within the preputial orifice the epithelium of the vesicles is soaked off, little ulcerations result, more or less general inflammation is likely to arise from retention

[1] Cf. Goldsmith, *Lancet,* 1898, ii, 387.

[2] *Arch of Surg.,* 1890, ii, 17.

[3] *St. Louis Med. and Surg. Jour.,* 1893, lxiv, 221.

of the secretions, and balanitis, with posthitis, vegetations, and inflammatory phimosis, may be the ultimate result. In exceptional cases the ulcerations become deep and angry, and the diagnosis from chancroid difficult, while the glands in the groin may inflame and suppurate. Such extreme results are rare.

When the affection has once occurred, it shows a marked tendency to recur. There is often a periodicity about the attacks. A tight prepuce and contact of irritating discharges act as predisposing causes.

Diagnosis.—Vesicles, usually in groups, always precede the ulcerations, while the latter are irregular in shape, superficial, and very rarely complicated by suppurating bubo. The pus is not autoinoculable.

Treatment.—The treatment is the same as for balanitis. As soon as the vesicles break a dry antiseptic powder is suitable (nosophen, calomel). In relapsing cases circumcision often effects a permanent cure.

Herpes Zoster.—Zoster may occur upon the penis as elsewhere.

Balanoposthitis. — Balanitis (*βάλανος, a gland*) is an inflammation of the surface of the glans penis. Posthitis (*πόσθη, the prepuce*) is an inflammation affecting the mucous surface of the prepuce chiefly. Neither can exist for any length of time without becoming more or less complicated by the other. For practical purposes they must be considered together.

Etiology.—Persons of irritable skin and gouty habit are predisposed to this disorder. A long and tight prepuce is always a predisposing cause. The exciting causes are mechanical irritation or uncleanliness from retention of smegma, or from contact with diabetic urine, gonorrheal, leukorrheal, menstrual, or other irritating fluids.

Symptoms.—The membrane at first becomes reddened, then mottled and moist; next the epithelium comes off in patches, leaving irregular excoriations which soon ulcerate and discharge a purulent fluid. The ulcerations are not preceded by vesicles. There is a burning soreness with itching at the end of the penis, usually scalding on urination. The entire substance of the prepuce may inflame, become intensely reddened around the orifice and infiltrated with serum, producing inflammatory phimosis, especially if the prepuce be naturally long or tight. The ulcerations rarely become deep, and the inguinal glands do not often suppurate, but they may grow somewhat large and tender. In chronic balanitis with phimosis, the mucous surface of the prepuce is granular and even condylomatous.

R. W. Taylor [1] has described a peculiar ringed affection of the prepuce and glans—narrow rings of reddened mucous membrane covered by a thin layer of epithelial scales. The inclosed area is normal, the rings vary from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. The affection is sometimes

[1] *Arch. of Med.*, 1884, vol. xii, No. 3.

painful or itching. The rings remain stationary for a time. They may come out in successive crops. They get well without scar, slowly, under the use of arsenic internally. They should not be confounded with *lichen planus* of the glans penis.

Kaufmann [1] mentions a *diphtheritic banaloposthitis* occurring in the course of acute exanthems or by infection during circumcision. Taylor [2] has seen similar cases, some of them, when neglected, going on to gangrene and death.

Diabetic balanoposthitis is not uncommon. It is caused by contact of the saccharine urine. In these cases German investigators have found a fungus which they regard as characteristic; Friedrich [3] even going so far as to diagnose diabetes from the presence of this fungus in the balanitic secretion, there being not enough sugar in the urine to respond to the copper test. "Eczema of the genitals . . . is undoubtedly set up by the irritation produced by torulæ and other organisms which grow in the saccharine moisture remaining on the parts" (Soundley [4]).

Although Hebrews are predisposed to diabetes, circumcision saves them from this complication.

Diagnosis.—Balanitis may be confounded with herpes, chancroid, chancre, or gonorrhea. At the ulcerative stage it cannot be distinguished from balanitis supervening upon herpes. If herpes be seen early its vesicular origin distinguishes it. Chancre is usually single and indurated. In chancroid the ulcerations are deeper and the pus autoinoculable, yet both of these specific ulcers may be complicated by balanitis. Balanitis may be mistaken for actual gonorrhea if there be phimosis, under which circumstance it is very likely to complicate the main malady. When the meatus urinarius can be seen, however, it is easy to decide whether the pus comes from within the urethra or not.

Prognosis.—While balanitis usually yields readily to appropriate treatment, diabetic cases are intractable as long as the exciting cause, glycosuria, persists, while the chronic balanitis of gouty individuals is as difficult to cure as the eczema from which they suffer.

Adhesions due to balanitis are uncommon after early childhood. In elderly persons, however, the possibility of epitheliomatous degeneration in a patch of chronic balanitis must be borne in mind.

Treatment.—If the prepuce can be easily retracted without causing paraphimosis, simple balanitis may be speedily relieved. Cleanliness is of the first importance, but soap should not be used. Warm water and peroxid, āā, will remove all the discharges. After washing, the parts

[1] Billroth and Lücke, *Deutsch. Chir.*, Part 50 a.

[2] "Venereal Diseases," 1897, p. 393.

[3] *Virchow's Archiv*, 1864, xxx, 476.

[4] "Albutt's Sys. of Med.," 1897, iv, 217.

should be dried by gently touching them with a soft cloth, and dusted (by the aid of a dry camel's-hair brush from which the powder may be evenly shaken) with bismuth and calomel, nosophen, or any fine stimulating powder. A piece of old linen, just large enough to cover the glans, and with a hole cut in its center so that it may be slipped like a collar around the corona, is now to be moistened in a mild antiseptic solution (sublimate 1:10,000, or acetate of aluminum 2 per cent, or aromatic wine and water equal parts) and laid over the glans, leaving the meatus uncovered. The prepuce is then pulled forward to its natural position. In this way friction between the inflamed surfaces is avoided, all the discharges are absorbed, and a mildly stimulating fluid is kept in constant contact with the ulcerated or abraded surfaces. The dressing should be repeated two to four times daily, according to the discharge. After recovery a dry piece of linen should be kept between the glans and the prepuce for some weeks, renewed twice daily.

If the prepuce cannot be retracted, its *cul-de-sac* should be thoroughly washed out from two to six times a day, according to the severity of the inflammation, with diluted peroxid of hydrogen; and each time after the cavity has been cleaned, enough of one of the lotions above mentioned to distend the prepuce should be gently thrown in, retained a moment, and then allowed to escape.

If the prepuce be much inflamed, rest, position, and wet antiseptic dressings locally should be used in addition to the other measures. If the inflammation run so high that sloughing seems imminent, it is better to take off the tension by slitting up the dorsum. If chancroid be present, inoculation of the wound is inevitable. Yet chancroidal cases require operation most urgently in order to expose the sore, whose ravages (perhaps upon the glans penis) are progressing uncontrolled. A large chancroid exposed is better than a small one concealed.

Circumcision.—In chronic and inveterate cases, or where insignificant causes produce constant relapse, circumcision affords a certain cure. Where this is seriously objected to, which is rarely the case when there is much suffering, relapses may be rendered less frequent by the observance of the strictest cleanliness and the use of a solution of tannic acid in glycerin (10 per cent), or of alcohol (33 per cent) kept up for a long time, followed by long use of a piece of dry linen to separate the mucous surfaces.

Circumcision in diabetics, while almost certain to prove curative, is no light matter. Diabetics bear any operative interference very ill, and several deaths from circumcision are recorded. Therefore, while trying the milder methods, special attention should be paid to the patient's general condition, in order that, if these methods prove unsuccessful, operation may be undertaken with the greatest possible chance of success.

ACUTE INFLAMMATORY AFFECTIONS OF THE PENIS

Superficial inflammation of the penis, while rare and usually mild, may require energetic treatment; for, though the vascular supply is abundant, the vessels, lying in a loose, cellular tissue, become occluded by slight inflammatory exudates whence gangrene or chronic edema results, and, moreover, the numerous lymphatics and the loose subcutaneous connective tissue encourage rapid dissemination of the inflammation.

The inflammation is rarely traumatic, usually venereal, and sometimes arises from the neighboring parts.

The *varieties* of acute superficial inflammation are cellulitis, lymphangitis, and erysipelas.

Cellulitis.—Cellulitis arises from chancroids, balanoposthitis (especially if complicated by phimosis), traumatic infection, or gonorrheal periurethritis. The inflammation may spread to the abdomen, scrotum, or thighs, or it may involve the erectile bodies, thus adding the dangers of embolism, retention of urine, and urinary infiltration, and greatly increasing the tendency to gangrene.

Lymphangitis.—Lymphangitis is comparatively benign. A lymphangitis of the large dorsal lymphatic may be differentiated from phlebitis of the dorsal vein by the fact that the cord of induration extends outward, at the root of the penis, toward a group of enlarged glands, instead of disappearing beneath the symphysis pubis.

Erysipelas.—Erysipelas of the penis is rarely seen nowadays, though it was formerly not uncommon. It usually spreads to the penis from the adjoining regions, though it may originate in a local lesion. It is likely to be virulent and complicated by cellulitis (phlegmonous erysipelas).

Treatment.—Prophylaxis, by careful treatment of the causes of inflammation, is of the first importance. If the penis has already become inflamed it should be elevated, with the scrotum, by a T-bandage and wet dressings of sublimate (1:10,000) or aluminum acetate (2 per cent) applied daily. Rest in bed, free purgation, and a light diet are essential in the more severe cases. Tension may be relieved by scarification or incision, abscesses must be opened and drained, and sloughs speedily removed.

In erysipelas, dressings of ichthyol (50 per cent in glycerin and water, painted on) are especially valuable. A subsiding lymphangitis may leave a chronic induration behind it.

Cavernitis and penitis (inflammation of the corpora cavernosa or of all three erectile bodies) arise from cellulitis or its causes, especially inflammation in the bulb of the corpus spongiosum. Sexual excess (Demarquay) and iliac thrombosis have also been incriminated.

Course.—The course of the disease is that of an acute inflammation with constant priapism and edema added to the usual local symptoms. While the inflammation may be walled in by occlusion of the vascular spaces, pyemia is "a terribly frequent complication" (Jacobson).

Treatment.—The treatment should therefore be most energetic. Indurations in the erectile bodies should be freely incised, packed to check the hemorrhage, and irrigated frequently. This treatment and, in doubtful cases, the diagnosis, may require general anesthesia. Wet dressings should be employed.

Acute Gout of the Penis.—Sir J. Paget [1] reports a case in which penitis and urethritis alternated with and accompanied typical gouty symptoms. Sir Dyce Duckworth [2] chronicles a similar case. Priapism and retention were the chief symptoms.

OTHER DISEASES OF THE PENIS AS A WHOLE

Neuralgia of the Penis.—In some cases this might be classified as a gouty condition. The gouty diathesis, a neurotic temperament, and previous urethral disease are the chief etiological factors. The pain may be paroxysmal or continuous. It may be felt at the meatus, along the urethra, or throughout the organ. The first point in *treatment* is to insure the good health, physiological as well as anatomical, of the genito-urinary organs by appropriate treatment and insistence upon urethral and sexual hygiene. Following this the neurotic or gouty propensity must be combated. I have found the administration of large quantities of water, with alkalies or uric-acid solvents, peculiarly efficacious. Jacobson mentions a cure by colchicum.

Chronic Edema.—Chronic edema may be caused by elephantiasis or by general anasarca. The swelling of the scrotum usually overshadows that of the penis and may be so great as practically to obliterate that organ. In the penis the edema is greatest in the prepuce and especially about the frenum. This edema may offer a mechanical impediment to urination, and the low vitality of the tissues renders them especially liable to become inflamed by contact with the urine that dribbles over them.

Treatment.—The prepuce must be kept dry and dusted with a soothing powder. Multiple punctures or incisions may liberate the exudate sufficiently to keep the swelling within bounds, and, these failing, a dorsal incision will succeed. Light edema may be controlled by bandaging and elevation.

Dilatation of the Lymphatics.—This condition is secondary to trauma or inguinal adenitis. The dilated lymphatics appear as white,

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[1] *Op. cit.*, p. 684.

[2] *Trans. Clin. Soc.*, Lond., 1891–92, xxv, 97.

subcutaneous cords encircling the penis behind the corona or extending along the sides or dorsum. There are no subjective symptoms and the obstruction may be relieved spontaneously. For esthetic reasons multiple ligation or total excision may be resorted to, but a lymph fistula may result from such treatment.

Elephantiasis.—This condition is so rare in the penis alone that the whole subject receives more appropriate treatment with diseases of the scrotum.

Gangrene is usually the result of inflammation. It may, however, come on independent of any local inflammation. Spontaneous gangrene usually occurs in connection with the acute exanthems. Cases have been reported from typhoid, typhus, intermittent fever, and small-pox. Senile and diabetic gangrene also occur. Cases following prolonged priapism, iliac thrombosis, atheroma of the dorsal artery, exposure to cold, and acute alcoholism are also cited by Jacobson.

Treatment.—The prophylactic measure—incision of inflammatory and edematous areas—has already been noted. When gangrene has once declared itself, attention to the patient's general condition, the preservation of dryness, asepsis, and warmth locally, and the prompt removal of all frankly gangrenous tissue are the therapeutic indications. Later, plastic work may be required to cover areas left bare of integument. Cicatricial deformity of the erectile bodies can be remedied only by time and by such physiological rest or exercise as may suit each individual case.

Tuberculosis.—Tubercular urethritis apart, tubercular ulcers may appear upon the glans or result from infection during ritual circumcision. Senn [1] relates two cases illustrating the difficulty of differentiating the lesions of gumma, tubercle, and cancer. The diagnosis may depend upon the pathological examination of a snipping from the ulcer.

Treatment.—Poncet [2] advises internal remedies, aided by the curette or the cautery. This course has proved satisfactory at Senn's hands.

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[1] "Tuberculosis of the Genito-Urinary Organs," 1898, p. 22.

[2] *La médecine moderne*, 1893, 750.

CHAPTER LXV

PHIMOSIS—PARAPHIMOSIS—TUMORS OF THE PENIS

Preputial Deformities.—Practically, the deformities of the foreskin (phimosis and atresia of the orifice excepted) are unimportant. The prepuce is sometimes bifid, enlarged into a pouch, redundant, projecting 1 cm. or more beyond the apex of the glans, or only rudimentary from arrest of development. Between these limits it may be of any length, covering more or less of the glans. When the prepuce is deficient, the epithelium of the uncovered glans penis becomes hard and tough, more nearly resembling ordinary cuticle. Under these circumstances its sensibility is diminished, but it is less liable to become excoriated or inflamed. Hence, absence of the prepuce is not to be regretted, and the operation for its restoration (posthioplasty) need not be described.

PHIMOSIS

Phimosis exists where the orifice of the prepuce is so small that the glans penis cannot be uncovered. The orifice of the prepuce may be congenitally absent (atresia preputii). Phimosis is congenital or acquired, simple or inflammatory, or complicated by other diseases or by adhesions.

In young children preputial redundancy is so common that it may be considered normal. The foreskin of an infant is developed out of all proportion to the rest of the penis, taking the member after puberty as a standard of comparison. This long prepuce is often a source of anxiety to young mothers, who fear that the condition may remain permanent. They may be assured that it will right itself as the child grows. Whenever the prepuce can be fully retracted there need be no anxiety about the future; the preputial orifice will enlarge sufficiently before or at puberty.

Phimosis may be brought about secondarily through induration and inelasticity of the skin caused by frequent attacks of preputial inflammation. The meshes of the connective tissue, at first distended with serum, become secondarily thickened and hypertrophied, leaving a thick, indurated, inelastic prepuce, interfering not only with sexual intercourse, but sometimes even with urination.

Another common cause of acquired phimosis is the cicatrization of multiple chancroids around the orifice of the prepuce. Infrequently, diabetic eczema produces phimosis. Demarquay quotes a case where a passionate and jealous woman made her lover wear a gold padlock with which she secured the preputial orifice, keeping the key herself. The victim of her charms carried his padlock, which was replaced from time to time through new punctures, during four or five years, until such a degree of irritation had been set up that Petroz and Dupuytren, when consulted, diagnosticated cancer, and removed the prepuce. No relapse of the cancer is recorded.

Treatment.—Though circumcision in infancy will leave the patient less subject to venereal disease and to sexual irritability in later years, popular prejudice opposes the mutilation unless the prepuce is so tight that it cannot be retracted.

A positive indication for operation upon a child does exist, however, where the preputial orifice is smaller than that of the urethra. This condition is evinced by ballooning of the prepuce during micturition, for the urine flows into the cavity more rapidly than it can escape from the orifice. In these cases the retention of a drop or two of urine in the cavity of the prepuce after each act of urination leads to inflammation of the mucous surfaces, and may give rise to suppuration, the growth of vegetations, formation of the preputial stone, or incrustation of the glans.

When the adult prepuce is tight, an operation may be called for as a prophylactic against future disease, even though phimosis, strictly speaking, does not exist. For example, the collection of smegma, or repeated attacks of herpes, may necessitate operation. Again, if an individual with a tight prepuce gets chancre, chancroid, or gonorrhea, serious inflammatory complications are likely to arise.

Inflammatory Phimosis.—Inflammatory phimosis is a transient condition. It may leave true phimosis behind, as above detailed, but usually does not. Any variety of phimosis may be complicated by inflammation. It is better not to circumcise when the prepuce is inflamed, as the process of repair is slow and an ugly cicatrix may result. If the inflammation is caused by chancroid, however, incision of the prepuce is usually required to cure the disease, though the wound will probably become infected with the chancroidal virus.

Treatment.—Keep the patient in bed and elevate the penis over the hypogastrium. Astringent wet dressings must be employed locally, while the cavity of the prepuce is irrigated repeatedly, as for balanitis. If this fails, incise or circumcise.

Remote Results of Phimosis.—Besides predisposing to local inflammatory disorders, leading to imperfect development of the glans penis, and acting as an obstacle to sexual intercourse, phimosis may occasion

a variety of morbid conditions by reflex action. It may excite frequent desire to urinate (irritability of the bladder), even cystitis; but its disturbing influence in a reflex way upon the rest of the organism I believe has been very much overrated.

Prolapsus ani and hernia not infrequently accompany phimosis in children, and symptoms resembling those of stone in the bladder are not uncommon from the same cause.

PARAPHIMOSIS

Paraphimosis exists when the prepuce is retracted behind the corona glandis and cannot be replaced.

Causes.—An unnaturally tight preputial orifice is a predisposing cause to paraphimosis. It sometimes happens that young boys, who retract the prepuce, perhaps for the first time, find themselves unable to replace it.

Inflammatory paraphimosis may depend upon balanitis, gonorrhea, herpes, chancroid, chancre, etc. The prepuce, already a little inflamed,

Fig. 129.—Paraphimosis.

is retracted for the cleansing of some ulceration concealed in its *cul-de-sac*, or is, perhaps, held back by bandage for convenience of dressing, until reduction becomes impossible.

Symptoms.—In paraphimosis the glans penis is swollen and livid. If the patient is seen at once there may be no inflammation either of the prepuce or of the glans; but in most cases—in all eventually, if unrelieved—both are inflamed to a greater or less extent. Behind the corona, most marked below, rises a tense, shining, edematous belt of the

Fig. 130.—Paraphimosis. The edema is squeezed out preparatory to reduction.

mucous layer of the prepuce, the connective tissue of which is filled with serum. Behind this there is a deep sulcus or furrow, most marked above, often the seat of superficial ulceration. Here lies the stricture; behind it there rises another edematous fold, usually smaller than the one in front (Fig. 129).

If the stricture of the prepuce is tight enough to arrest the circulation, it may finally cause the destruction by gangrene of all tissues lying in front of it.

Treatment.—The first point to decide in a case of paraphimosis is in regard to strangulation. If this exist, delay is inadmissible; if not, temporizing expedients may be resorted to, to reduce inflammation before appealing to forcible reduction or operation. The test is simple. In strangulation the glans penis is turgid, swollen, blue-black, cold, devoid of sensibility, and perhaps already showing points of commencing gangrene. If there be no strangulation, the glans may be normal, or, if swollen, is red—at least not black—warm, and by

compression the blood may be driven out of it; sensibility is also preserved.

Reduction.—Reduction may almost invariably be accomplished without incision, if the following details are observed, viz.:

1. The stricture must first be pulled well back. Exceptionally the mucous membrane is unfolded at the dorsum; this must be smoothed out by still further retracting the prepuce.

2. The edema must be thoroughly squeezed from in front of the stricture to the shaft of the penis behind it. Until one has patiently squeezed such a penis for several minutes, it is quite incredible how fully the edema may thus be reduced and shifted to the shaft of the penis (Fig. 130).

3. Reduction is then accomplished by forcing the head of the penis very slowly through the stricture—so slowly as to squeeze out the remaining edema. It is futile to attempt to pry the stricture over the glans until the edema has been reduced.

Fig. 131.—Reduction of Paraphimosis.

The following is the best method of reduction: Seize the penis behind the strictured prepuce in the fork of the index and middle fingers of both hands, one placed on each side. This gives more even pressure forward than when one hand only is used. Now make pressure with the thumbs on both sides, in such a direction as to compress the glans laterally, rather than from before backward, and at the same time pull the strictured portion of the prepuce forward, the idea being rather to pull the stricture over the glans than to push the glans through the stricture (Fig. 131).

If a prolonged, careful attempt at reduction fails, the strictured point must be divided. To accomplish this subcutaneously, a tenotomy knife is introduced flatwise through an incision on the dorsum of the penis near its root, and slipped forward beneath the skin until its cutting edge is within the stricture. By simply turning the knife the stricture may then be nicked from within outward until all tension is relieved. Inflammatory consolidation of tissue may make it necessary to divide the stricture at several points. This subcutaneous incision presents the advantage over the usual open incision of being more easily insured against infection.

After reduction, the treatment consists in position, rest, and cleanliness, and syringing the preputial cavity with a mild antiseptic solution.

TUMORS OF THE PENIS

Gumma.—Gumma occurs often in the prepuce, very rarely in the urethra and the corpora cavernosa. In the first two localities it may be mistaken for tuberculosis or cancer. The history, the influence of mixed treatment, and, if necessary, the examination of a section of the growth determine the diagnosis. In the corpora cavernosa it resembles circumscribed fibrosis, but is deeper, less cartilaginous, and almost always occurs in the posterior third of the organ (Zeissl). Gummata never increase in one direction while healing in another, and they are likely to break down and soften. The so-called relapsing chancre is a gummatous deposit in the scar of the initial lesion.

Benign Tumors of the Skin and Connective Tissue

Cysts.—Mucous implantation, and sebaceous cysts occur. The last originate in the sebaceous glands of the skin or in Tyson's glands. Cysts occur almost always in the prepuce and are readily enucleated. (Cf. Gerulanos.[1])

Benign Neoplasms.—Lipoma, adenoma,[2] and angioma have been described. They are rare, and their removal is a question of judgment involving a recognition of the function of the penis as an intromittent organ, and the possible loss of this function from the formation of a cicatrix.

Papilloma.—More important because of their frequency are the papillomata (*warts or vegetations*) of the penis. They are commonly denominated *venereal warts*. This title, however, is not exact, since there is no necessary connection between them and any venereal disease. They are papillary overgrowths, often highly vascular, and composed of epithelium. They may be prominent and pedunculated, or flat, and growing from a considerable surface. They are nearly always multiple. They are caused by the contact of irritating fluids with a membrane of naturally delicate texture, or simply by lack of cleanliness. Consequently the most favorable condition for their production exists in gonorrhea, in balanitis, or when mucous patches occupy the cavity of the prepuce. Their favorite seat is just behind the corona glandis, but they are also encountered anywhere within the cavity of the prepuce, at its orifice, upon its cutaneous surface, or even within the urethra. They are found also upon the scrotum, and frequently around the anus. They are, when numerous, bathed in a fetid, puriform secretion, and may grow large enough within the prepuce to cause phimosis. They occur upon young children, and are found in their greatest luxuriance

[1] *Deutsche Zeitschr. f. Chir.*, 1900, lv, 326.

[2] "Morrow's System," 1893, i, 58.

within and around the vulvæ of women affected with irritating discharges—discharges not necessarily venereal in any sense. Implantation warts also occur after circumcision.

Diagnosis.—Warts should be differentiated from mucous patches and condylomata by the typical flat appearance of the syphilitic lesions and the accompanying symptoms of the disease.

From commencing epithelioma the diagnosis may be extremely difficult if the base is a little dense. When in doubt examine a snipping under the microscope, and if it appears benign, treat it as such, but remove it in any case. If it recur, and the patient is over fifty, it is safest to exsect it as though it were epitheliomatous, whatever the findings of the pathologist.

Prognosis.—Unless kept scrupulously clean, warts sometimes ulcerate, and they may even suppurate, light up suppurating buboes, and even cause gangrene of the penis. Simple cleanliness, on the other hand, often causes them to atrophy.

Epitheliomatous degeneration may take place, and is always to be feared. Implantation warts are especially liable to hypertrophy and become *horns*.

Treatment.—The observance of cleanliness alone often causes vegetations to shrink up and disappear. In any case this is the first essential to the success of any course. In case vegetations are complicated by balanitis, treatment of the latter will often at the same time triumph over the warts.

The most valuable local application is a 10-per-cent mixture of salicylic acid in acetic acid.[1] This forms a chalk-and-water mixture of which the moist chalk is smeared over the warts. One or two applications cause the growths to wither away and drop off. Relapse does not seem to occur after this treatment. If they persist, however, or constitute the main disease, all the pedunculated growths may be removed with curved scissors, and the surface from which they grow cauterized with nitric acid or any other escharotic. The flat growths may be disposed of by the application of nitric acid, at intervals, until the base from which they spring has been destroyed. The X-ray and radium are efficacious for obstinate cases.

Meanwhile attention to the general health, cleanliness, and local dusting with calomel is the proper course. This plan, so efficacious in treating condylomata and mucous patches about the anus, is particularly applicable if the vegetations are surrounded by an excess of moisture.

Horns.—Horny growths may spring from the glans or the integument. They begin as warts and are very prone to epitheliomatous change. Brinton,[2] of Philadelphia, has described a curious case and

[1] Not glacial.

[2] *Med. News*, 1887, li, 141.

collected others from the literature. Baldwin [1] and Bruce Clark [2] mention others.

Benign Tumors of the Erectile Bodies

The benign tumors of the erectile bodies of the penis are four: *circumscribed fibrosis, enchondroma, osteoma, and calcification.* The first is comparatively rare, the others extremely so.

Circumscribed Fibrosis.—I have come to prefer this name for the malady heretofore usually known as *chronic circumscribed inflammation of the corpora cavernosa,* for the condition is a fibrosis, not an inflammation, and though it usually affects only the corpora cavernosa, the corpus spongiosum as well is sometimes involved.

The malady is gouty in origin, comparable to Dupuytren's contraction of the palmar fascia. It usually appears between the ages of thirty-five and fifty.

Pathology.—The growth occurs in the sheath of the erectile body. It is a fibrosis which may show patches of enchondroma (Tuffier and Claude [3]).

Symptoms.—The affection comes on insidiously, without apparent cause, although the patient sometimes ascribes it to local injury. The first symptom is a bending or a slight pain at a certain point in the penis when the organ is erect. Examination detects a hard, flattened mass with sharply defined margins, occupying the substance of one or both corpora cavernosa near the surface, and feeling like cartilage—elastic, springy, not as bony as a calcareous plate. The corpus spongiosum rarely participates in the disease. The penis bends during erection at the affected point, and along the edge of the hardness a little pain is experienced. This indurated mass, which is usually irregularly oval in shape (often with a projecting line of hardness toward the root of the penis), may remain stationary for an indefinite period; or it may progress slowly backward or forward, sometimes retaining its size and shape, sometimes growing larger, sometimes smaller.

A slight tenderness is perhaps felt along the line of advancing induration, and moderate uneasiness is usually produced by pressing the induration between the fingers or by erection. The seat of election is the dorsum of the penis forward, the patch spreading equally around each corpus cavernosum. Sometimes a single patch is found laterally in one corpus cavernosum, not reaching the dorsum, and there being no companion on the other side.

Prognosis.—The prognosis is negatively good in that the fibrous mass never ulcerates or degenerates into anything malignant, may get spon-

[1] *Med. News,* 1887, li, 449. [2] *Lancet,* 1894, i, 219.
[3] *Guyon's Annales,* July, 1885.

taneously better, even possibly well, or may, and sometimes does, develop backward until it gets so low down toward the root of the penis that it no longer seriously interferes with upright erection. I have seen more than one patient who, at one time being debarred from sexual intercourse, has by a shifting of the position of the induration again become potent. I have met one person with a distinct plaque of some size, of which he had no knowledge whatever until I called his attention to it. The distinction between fibroma and enchondroma can only be made pathologically; clinically it is unimportant. The tendency to ossification manifests itself so rarely that it is a negligible quantity.

Treatment.—An effective treatment of this singular malady is yet to be discovered. Thus far time only has seemed to help it.

Thiosinamin, antisclerosin injections, blisters, oleate of mercury, tincture of iodin, the iodids, and electrolysis, have uniformly failed. Perhaps alkaline or antigouty remedies may have some beneficial effect. I always try them, and have thought they encouraged resolution in some cases. Yet in others they are absolutely inefficacious. Excision only replaces the fibrosis by scar tissue.

Calcification and Ossification.—Both of these conditions are usually, probably always, secondary to fibrosis, or enchondrosis of the erectile bodies. Calcification of small patches is quite rare, ossification is even more unusual. Cases of this latter condition have been reported by von Lenhossek,[1] Demarquay,[2] Porter,[3] Jacobson,[4] and Chetwood.[5] In Chetwood's specimen certain spots were simply fibrous, others were cartilaginous, while the bulk of the growth was true bone. To compare penile osteoma with the bony development normal in the penes of certain monkeys is scarcely logical.

Prognosis.—Calcification or ossification may cease after more or less of each corpus cavernosum has suffered, or it may involve the whole organ pretty generally. Sexual intercourse may be seriously interfered with, if not prevented altogether.

Treatment.—Medicine holds out no hope to the sufferer. If the disease has come to a standstill and the deposit is superficial and small, it may be removed with the knife—an operation which has been performed with success by Regnoli, MacClellan, and others.

Malignant Neoplasms of the Penis

The primary malignant new growths of the penis are *sarcoma* and *epithelioma*. The former is very rare. It arises from the erectile bodies, usually the corpora cavernosa. The latter, much more common,

[1] *Virchow's Archiv*, 1874, lx, i.
[2] *Op. cit.*, p. 354.
[3] *N. Y. Med. Record*, 1882, 270.
[4] *Op. cit.*, p. 683.
[5] *Jour. of Cut. and Gen.-Urin. Dis.*, 1899, xvii, 231.

begins on the glans, on the prepuce, or in the urethra. Epithelioma of the urethra is considered with the other diseases of that canal.

Secondary new growths present no peculiar features. They either form part of a disseminated carcinosis or are mere extensions of the tumor from an adjoining region, usually the scrotum.

Sarcoma.—With or without previous trauma a tumor appears in one of the erectile bodies. The fact that it is a distinct lump and not a flat indurated patch readily distinguishes it from the benign tumors of these structures. Moreover, sarcoma usually appears in early manhood and develops with characteristic rapidity and early involvement of the inguinal glands. Exceptionally, however, it grows slowly and the glandular involvement occurs late. Of the 13 cases recorded by Jacobson [1] some arose from the erectile tissue, some from the fibrous sheath, and one—a melanotic sarcoma—apparently originated in the urethral mucous membrane. The earlier cases were reported as fibroma or carcinoma. As the tumor grows it causes priapism by occluding the cavernous spaces, and may also occlude the urethra and so cause retention of urine. Early amputation of the penis is the only *treatment*. The *prognosis* is absolutely bad.

Fig. 132.—Epithelioma of the Penis (Wyeth).

Epithelioma.—Epithelioma of the penis (Fig. 132) begins on the prepuce or glans, both of which are usually involved when the patient presents himself for examination.

Etiology.—Though Freyer [2] has reported a case in a youth of seventeen, and Kaufmann places 6 per cent of the cases in the third decade, here, as elsewhere, epithelioma is usually a disease of later life. One case developed in the scar of a horse-bite, others have arisen from the scars left by venereal sores, a few from ure-

[1] *Op. cit.*, p. 738.

[2] *Brit. Med. Jour.*, 1891, i, 1173.

thral fistula; but warts and chronic balanitis are the most fruitful sources of epithelioma, the former especially if neglected and allowed to remain foul and moist. Indeed, 29 out of 33 cases collected by Kaufmann began as apparently benign warts. Finally, phimosis is a marked predisposing cause of epithelioma. By retention of the smegma and urine it predisposes the patient to balanitis, vegetations, and fissures of the foreskin, and these processes once set up are kept concealed and constantly bathed in an acrid and irritating fluid. Demarquay noted phimosis in 42 out of 59 cases, and it is claimed that the circumcised Jew is exempt from penile epithelioma. The question of inoculation from the cervix uteri is agitated from time to time, but the extreme rarity of the cases adduced indicates that they represent nothing more than a curious coincidence.

Symptoms and Course.—Although epithelioma of the penis is not often seen until well under way and absolutely characteristic, the various aspects under which it first presents itself must be appreciated in order that intelligent radical treatment may be resorted to early.

In about 5 out of 6 cases the disease begins as a wart situated on the glans or on the inner surface of the prepuce. This wart is intractable to ordinary methods of treatment, and recurs if cut or burned away. As it grows it assumes a lobulated, cauliflower appearance, and soon begins to ulcerate in places, and to exude the characteristic foul ichorous discharge. Then the base gradually takes on the hard induration of the epitheliomatous ulcer with everted edges. By this time the inguinal glands are probably involved and may be felt as shotty subcutaneous nodules in either groin. (For the lymphatics of the penis so anastomose that a so-called crossed bubo—the sore on the one side of the penis and the bubo in the opposite groin—occurs not infrequently.)

More rarely epithelioma begins as a raw spot or an indolent ulcer, and still more rarely it appears first as a subcutaneous nodule or pimple or as a patch of leukoplakia.

In whatever way the disease begins, it comes after a time to the frankly cancerous stage. The ulcer advances, involving all the tissues in its path; the discharge is thin, sanious, fetid; the ulcer deep, irregular, unhealthy, its edges hard, livid, and everted. At the same time the exuberant warty growth progresses, either of these conditions predominating to make the case clinically a warty or an ulcerative lesion.

The inguinal glands now become prominent and partake of the pyogenic as well as of the cancerous infection, so that they become matted together, and may even suppurate and produce an epitheliomatous ulcer in the groin.

Locally, the growth may spread over quite a large superficial area without involving the corpora cavernosa, whose sheaths stoutly resist invasion, while it has frequently been noted that, though the entire glans

may be involved in the disease, the corpus spongiosum is usually spared and urination is unimpeded. If, however, the canal does become obstructed, the urine usually manages to find its way through one or more fistulous openings in the floor of the urethra.

Yet when the penis is amputated unsuspected malignant nodules are often discovered scattered along the corpora cavernosa.

Lancinating pain is a prominent symptom only late in the disease. The chief inconveniences to the patient in the earlier stages are the presence of the growth, the foul discharge, and the tendency to annoying hemorrhage after the slightest abrasion. As the disease advances the strength of the patient fails. The tumor spreads up over the penis to the pubes, abdomen, and thighs, joining the ulcerated inguinal glands and extending down over the scrotum to the perineum, anus, and buttocks, until, finally, the patient dies of sepsis, cachexia, or hemorrhage. Curiously enough, lymphatic infection seems to stop for a long while at the inguinal glands, so that visceral metastases are exceptional.

Diagnosis.—The diseases which may be confused with epithelioma of the penis are warts, chancre, chancroid, tubercular ulcers, and ulcers from chronic balanoposthitis.

As we have seen, the appearance of epithelioma is characteristic enough after its base has become indurated and the infection has begun to spread to the inguinal glands; but it is of the greatest importance that the diagnosis be made before that time, while the disease is yet eminently curable. To this end all growths or ulcers that prove intractable should be regarded with suspicion, and if that suspicion is confirmed by microscopical examination of a snipping from the diseased tissue, immediate operation should be insisted upon.

Prognosis.—Before the inguinal glands become involved the prognosis is good. Afterwards it is bad, yet not absolutely so, for cures are reported in cases where unmistakable gland involvement had occurred. Thus Küttner [1] found a mortality of only 40.5 per cent in 58 cases reported from three to twenty-nine years after operation. Indeed, in a few cases, slight glandular enlargements have been known to disappear permanently upon removal of the original focus of infection, as though the adenitis were purely inflammatory.

The glands can and should be removed with the tumor, yet, in spite of the fact that infection is slow to pass them, the situation of these organs about the saphenous opening in the fascia lata, in close proximity to the great vessels, and the accompanying simple inflammation that usually mats the glands to one another and to the vessels themselves, render their removal an extremely delicate task and one of whose thoroughness the surgeon cannot always feel assured.

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[1] *St. Louis Courier of Medicine*, 1899, xxi, 72.

Treatment.—If the growth be seen before induration has occurred it may usually be removed by circumcision if on the prepuce, or by thorough cauterization if upon the glans. Patches of leukoplakia upon the glans penis or the foreskin should be promptly destroyed by knife or thermocautery. The patient should, however, be warned of the danger of recurrence, and should this appear, or should there be already some induration about the base of the tumor, the penis must be amputated behind the corona, and the inguinal glands of both sides extirpated, whether they are palpably enlarged or not, for the microscopic has repeatedly shown these glands to be the seat of malignant deposits though their gross appearance was quite normal.

If the glans is extensively involved, the penis must be amputated close up to the pubes, or else extirpated entirely. Jacobson claims that simultaneous castration adds to the comfort of these patients, though most men refuse to part with their testicles even when their function has thus ceased.

Even though the disease has progressed still further, the ingenious surgeon will devise some irregular plastic operation which can be combined with complete extirpation to suit the exigencies of the case. The hope of cure may be slight indeed, but by vigorously attacking every outburst of the disease the surgeon may hope to prolong life for months or years and to render the sufferer at least fairly comfortable during that period. The various escharotics, the actual cautery, permanganate of potash and peroxid of hydrogen are of no small service in this terminal stage of the disease. Occasionally an actual cure may even be obtained, as in Taylor's case of removal of an epithelioma which had existed for six years. The patient died of intercurrent disease ten years after the operation, having shown no recurrence.

CHAPTER LXVI

CHANCROID

Custom in America has adopted the name "chancroid" (originated by Clerc) for that form of contagious venereal ulcer which is not accompanied by constitutional syphilitic infection. Chancroid (or soft chancre) and hard chancre are no more akin than measles and leprosy; and it is unfortunate that the ancient confusion of the local and the general infection has left us this legacy of misleading terms; but it is now too late to change them.

DEFINITION

Chancroid is a specific, local, contagious, autoinfectious venereal ulcer.

It is specific in that it is caused by a specific microörganism, the streptobacillus of Ducrey.[1]

This bacillus is dumb-bell shaped, thick and rounded or square at the ends, constricted in the middle. It varies in length from 1.5 to 2 μ. It groups in parallel chains, and occurs both inside and outside the cells (Fig. 133). It stains readily with the ordinary dyes (methylene-blue, or violet, or fuchsin), and is decolorized by the Gram stain.

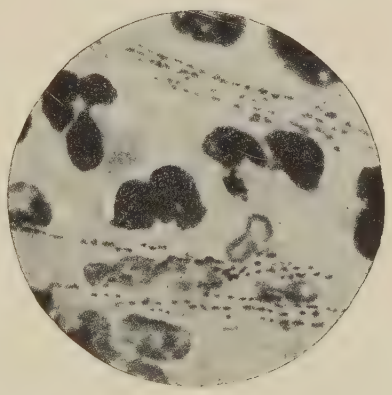

Fig. 133.—Streptobacillus of Ducrey. (Lincoln Davis.)

For many years after its discovery in 1889, in spite of the confirmatory observations of Unna, Kretling, Dubreulh, and Lasnet, etc., and in face of the manifestly specific character of chancroid, the pathogenic action of the streptobacillus was doubted until proven by the culture and inoculation experiments of Istamanoff and Askpianz,[2] Lincoln Davis,[3] Lancret,[4] and Tomasczewski.[5] But chancroid is peculiarly

[1] *Riforma medica*, 1889, vol. v, p. 98.
[2] *Jahresbericht d. Path.—Microörg.*, 1898, vol. xiv.
[3] *Jour. of Med. Research*, 1904, vol. ix, p. 401.
[4] *Bull. méd.*, 1898, vol. xii, p. 1051.
[5] *Zeitschr. f. Hygiene u. Infect.*, 1903, vol. xiii, p. 327.

liable to mixed infection. A smear taken from the surface of the ulcer usually shows numerous pyogenic and other bacteria, and few if any of the pathogenic bacilli. Hence such a smear cannot be depended upon for diagnosis.

Chancroid is a local lesion, causing no systemic infection or reaction. *It is,* therefore, indefinitely *autoinoculable.* Indeed, the marked tendency to autoinoculation is one of the most striking clinical characteristics of the ulcer. That *it confers no immunity* whatever was amply proven by the disciples of syphilization. Lindemann, for example, inoculated himself 2,700 times with chancroidal pus in the vain hope of immunizing himself against syphilis. But a local and temporary immunity does exist; for after many inoculations a given region becomes immune, though the virus will still take on other parts of the body, and after several months' respite the first region loses its immunity. Clinically, however, such immunity has no significance.

Finally, *chancroid is a contagious venereal ulcer.* Of the three distinct venereal diseases, gonorrhea, chancroid, and syphilis, gonorrhea is, strictly speaking, the most venereal, being scarcely ever acquired except in sexual intercourse. Chancroid, though more virulent, is less venereal, since it recognizes many methods of infection other than sexual congress; while syphilis is the least virulent and the least venereal.

FREQUENCY

In the clinic, chancroids outnumber true chancres three or four to one. In private practice the preponderance is reversed, and we see five, or even ten, chancres to one chancroid. The reason for this is twofold. In the first place, chancroid can never make headway among cleanly persons, for it is so foul and disgusting that no decent citizen infected with it would attempt sexual intercourse until it is cured, and half a cure—such as so commonly conceals the infectiousness of syphilis and gonorrhea—is here impossible. In the second place, in most instances, a little soap and water at the time of exposure is an absolute safeguard against it; so that it flourishes only where soap and water are not esteemed.

METHODS OF CONTAGION

Not once in a thousand cases does one see a chancroid except about the genitals. This is as much as to say that it is practically always acquired by sexual contact. Although many cases of mediate contagion have been reported (the virus being usually conveyed by the hand), such cases are proportionately extremely rare. Indeed, chancroid will not "take" upon the integument unless it is abraded. Cullerier's experiments show

that this must oftentimes be true of the vagina as well. In two cases he deposited pus from a chancroidal bubo in a clean vagina, and let it remain there between half an hour and an hour. Then some of the vaginal secretion was collected and inoculated upon the thigh, after which the vagina was thoroughly cleansed. In both instances typical chancroids developed on the thigh while the vagina remained clean.

Hence, be it noted, a woman may convey chancroid from one man to another without herself becoming infected.

Yet autoinoculation of chancroid upon the healthy skin or mucous membrane lying in contact with it is extremely common. But it takes many hours of intimate contact to effect the inoculation.

SITUATION AND NUMBER

Chancroids upon the male genitals are most common in the coronary sulcus, especially in the little pocket on each side of the frenum. Persons with long foreskins may be inoculated anywhere within the preputial cavity, though urethral chancroid is extremely rare.

In women the sores usually occur about the introitus, rarely higher up.

From these regions the ulcers may spread by contact or by direct extension over external genitals, anus, thighs, abdomen, and even farther afield.

Chancroid commonly begins as a single ulcer; but no sooner has this appeared than secondary ulcerations begin, so that by the time the physician is consulted several sores are usually present.

SYMPTOMS AND COURSE

Incubation.—While Bumstead affirmed that chancroid has no period of inoculation in the sense that the pathological process begins from the moment of infection, it is, nevertheless, true that, clinically, the disease has an incubation period varying from one to ten days, usually three to five. When the incubation is protracted, this is probably due to the fact that the virus is retained some days within the prepuce (or vagina) before inoculation occurs.

Onset.—The symptoms of chancroid are best observed by studying the course of the artificial ulcer produced by inoculation. Within twenty-four hours after such an inoculation a reddish blush surrounds the puncture. This soon changes to an inflamed areola which, in the third day (rarely sooner or later), becomes a pustule. This extends quite rapidly, and within a few days breaks and becomes a characteristic chancroidal ulcer (Fig. 134).

The Ulcer.—The typical chancroid is a round ulcer with abrupt, perpendicular edge, as though it had been cut by a sharp punch. This edge may be undermined or everted. The ulcer is usually rather deep. Its base is irregular, grayish yellow, and covered by a pultaceous false membrane. It is surrounded by a non-indurated, inflammatory areola. The secretion is abundant and purulent. It bleeds readily. Though usually painless, when very active or phagedenic it may be intensely painful.

FIG. 134.—CHANCROIDS OF PREPUCE, PREPUTIAL FRENUM, AND GLANS PENIS, IN VARIOUS STAGES OF DEVELOPMENT. (Kaposi.)

Course. — If untreated and uncomplicated the ulcer increases in size for a week or two. Then, having attained a diameter of about 1 cm., it remains stationary for about two weeks, and then gradually heals by cicatrization from the edges toward the center. So rarely, however, is the ulcer both uncomplicated and untreated that the stage of spontaneous healing is not seen in the clinic.

COMPLICATIONS

The common complications of chancroid are mixed infection with syphilis (mixed sore), mixed infection with pyogenic microbes (inflamed chancroid), destruction of the frenum, phimosis, gangrene and phagedena, balanoposthitis and venereal warts, lymphangitis, adenitis (bubo).

The Mixed Sore.—*So long as your patient has chancroid you may never be sure that he has not chancre.* This rule is without exception. Its details and explanation, the necessary insistence upon the fact that a chancroid may readily conceal a chancre from the most experienced eye, as well as that other often-forgotten fact that, when the chancroid refuses to heal, it may be because of complicating *gumma*—these matters are discussed elsewhere (p. 719).

The Inflamed Chancroid.—While every chancroid is more or less irritated by its own secretions and contaminated by ordinary pyo-

genic microbes, the resulting inflammation is often insignificant unless due to friction—e. g., when the sore is on the edge of a long prepuce and subject to friction by the patient's clothes, or unless there is phimosis.

The chancroid at the preputial orifice is usually an interminable while getting well. The friction of shirt and drawers, or even the rubbing of the softest dressing, so irritates the sore that, though it may lose all its chancroidal characteristics and become a simple, sluggish abrasion, it lingers on week after week, taxing to the utmost the victim's patience and the physician's skill.

Chancroid underneath a long prepuce, however loose, usually excites so acute a cellulitis in the connective tissue of the foreskin as to cause *inflammatory phimosis*. This retains the secretions of the chancroid, which, bathed in this irritating pus and protected from effective treatment, promptly invades both glans and prepuce, and instead of healing tends rather to eat its way through the glans penis into the urethra or through the foreskin, at the same time setting up an intense inflammation, which may terminate in abscess, erysipelas, or gangrene. If the prepuce is retracted in a desperate effort to get at the suppurating cavity, paraphimosis complicates matters.

Destruction of the Frenum.—One of the commonest complications of chancroid is destruction of the preputial frenum. Indeed, the scar of this lesion may in after years prove most valuable in distinguishing chancroid from true chancre.

The frenum is destroyed in the following manner: a chancroid appears in the sulcus at one or both sides of the frenum; as it enlarges it eats a hole in the frenum, leaving a narrow string, which soon gives way as well.

The more widespread destruction of tissue that results from inflammation or phagedena requires no special mention.

Gangrene and Phagedena.—The terrible phagedena which, until the era of antisepsis, was an imminent possibility for every case of chancroids, has almost passed into oblivion with hospital gangrene and such ancient horrors. One can no longer imagine such a case as Ricord treated for several years, and which, commencing as a chancroidal bubo fourteen years before, was still an open ulcer at the knee.

On the other hand, *gangrène foudroyante* is still occasionally encountered as the complication of stricture, or of chancroid. Thus Martin [1] relates and depicts the case of a man who lost two thirds of his penis by gangrene in thirty-six hours. Happily, such cases are now extremely rare.

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[1] Morrow's "System," p. 875.

Lymphangitis.—Acute inflammation of the lymphatics running along the dorsum and sides of the penis toward the inguinal glands is a rare complication. Suppuration therein is much rarer.

Inguinal Adenitis.—Chancroid of the genitals causes inguinal adenitis or bubo. This complication occurs about once in every three cases. The bubo when bilateral is usually more severe on the side upon which the sore lies; but, on account of an abnormal lymphatic supply, the glands in the opposite groin may be the more inflamed. This is the so-called "crossed bubo."

The chancroidal bubo follows one of three clinical types:

It may be a simple inflammatory adenitis, the glands becoming large and quite tender, so remaining for a week or more, and then slowly resolving.

It may go on to periadenitis. The glands become matted together in irregular, tender masses adherent to the skin and to the subjacent tissues. When the inflammation reaches this stage it often terminates by suppuration; and when the abscess is incised or breaks, it heals in a way no different from suppurations elsewhere.

Finally, the inflammation may go through the same stages of adenitis, periadenitis, and suppuration; but when opened it forms an ulcer which soon assumes the aspect of a chancroid, the pus from which is autoinoculable. This is the so-called *virulent bubo.*

The obvious explanation of these variations in virulence is that the milder forms of bubo are due to the absorption of pyogenic microbes, and that virulent bubo is due to the absorption of the specific bacillus. But it has frequently been observed that, whereas the pus obtained from buboes at the moment of incision is very rarely chancroidal, it becomes so a few days afterwards.[1] Hence, it has been supposed that such buboes are infected secondarily with the chancroidal bacillus.

Recent bacteriological investigations have upset this theory. Tomasczewski [2] found that, although the microscope showed nothing in the pus from a freshly incised chancroidal bubo, culture on blood agar revealed streptobacilli of very slight virulence, while in older lesions the same bacteria were found with renewed virulence.

Now it has long been known that chancroidal pus, although it would remain virulent for many weeks if kept in a sealed tube, promptly lost its virulence when heated to a temperature of 105° F. It is, therefore, to be inferred that both "simple" and "virulent" buboes are due to

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[1] Thus Dubreuilh (*Jour. de méd. de Bordeaux,* 1893, vol. xxiii, p. 573) has reported an epidemic of chancroids producing 136 buboes. Of these, 27 did not suppurate; 43 were incised, the pus was sterile to culture and they healed rapidly; 51 became virulent, though sterile when incised; only 3 were virulent at the time of incision; and 12, which were open on admission to the hospital, were all virulent.

[2] *Arch. f. Derm. u. Syph.,* 1904, vol. lxxi, p. 11.

infection by the streptobacillus, but that the heat engendered in the inflamed gland is sufficient to reduce its virulence sometimes to the point of rendering it temporarily innocuous; so that it only requires a few days of cooling off, as it were, in the open ulceration to regain its primitive vigor.

DIAGNOSIS

The diagnosis of chancroid may be made by the microscope (which gives no negative assurance), by culture on blood agar, by the ancient and very trustworthy method of autoinoculation, or by confrontation (examination of the person from whom the sore was contracted).

To perform *autoinoculation,* cleanse a spot on the outer side of the patient's thigh with alcohol; then with a clean bistoury or pin wipe a little pus from the suspected sore; twirl the point of the instrument into the skin at the point to be inoculated just deep enough to draw the most minute drop of blood, smear the spot well with the virus, and clap on a vaccination shield. A "take" is announced by the appearance of a typical chancroid on the third day. This should promptly be destroyed by cauterization (see below).

The mere appearance of a pustule or an ulcer after inoculation proves nothing. It must be chancroidal in type to be considered trustworthy evidence. If, after inoculation, there is still some doubt of the nature of the "take," *its secretions may be examined for the Ducrey bacillus with better prospect of success than in the original sore,* or the diagnosis may be confirmed by hetero-inoculation (inoculation of another person). Gangrenous chancroid is said not to be inoculable.

Generally speaking, however, no test is required to establish the diagnosis of chancroid. The multiple, virulent sloughing ulcers, spreading by contact inoculation, the characteristic bubo, and the history of very recent exposure form a typical clinical picture. Inflamed herpes or simple ulcer may, however, very closely simulate beginning chancroid. Moreover, the chancroid may originate in the orifice of a sebaceous gland of the scrotum or penis (follicular chancroid), and so be mistaken at first for a small boil or an acne pustule. Bullous and ecthymatous forms of chancroid are extremely rare.

But the really important point in the diagnosis of chancroid is its differentiation from true syphilitic chancre. The details of this differentiation are considered elsewhere (p. 719); but it is not amiss to repeat once again that *no matter how sure you may be that a given sore is a chancroid, you cannot thereby make a negative diagnosis of syphilis;* for the same coitus that transmitted the chancroid may have transmitted syphilis, the chancre of which might not develop until after the chancroid was cured, or might develop on the chancroid, and so be insignificant as to escape the most careful scrutiny.

TREATMENT

Abortive Treatment.—Any chancroid not more than three days old may be cured by adequate cauterization. Chancroids from three to seven days old may often be thus aborted; but if the sore is more than a week old success is so rare that cauterization should not be employed; for, if it fails, it leaves the sore larger than ever.

It is an absolute condition to success that *every* sore be cauterized; not only those sores that have already developed, but also those that are only just beginning as minute pustules, or ulcers, but which, however small, can recontaminate their larger brethren, however well these be cauterized. Hence, nothing more futile could be imagined than cauterization of sores on the outside of the frenum so long as an inflammatory phimosis prevents access to those within the preputial cavity, or cauterization of balanitic chancroids in the presence of inaccessible urethral sores.

The simplest *method of cauterization* is the following:

1. Wash the ulcer and surrounding region with peroxid of hydrogen and water, equal parts; then dry.

2. Anoint the immediate neighborhood of the ulcer with vaselin to keep it from contact with the acids (not absolutely essential).

3. Cut several narrow strips of blotting paper. With one of these dry the surface of the ulcer.

4. Dip the pointed end of a glass rod into pure carbolic acid and apply it over the ulcerated surface. If there is any excess of acid running over the edge of the sore, quickly catch this with one of the strips of blotting paper. If there are several sores, carbolize them all before proceeding further.

The object of this step is *not cauterization, but anesthesia.* Carbolic acid will not destroy the bacteria in the tissues, but will, after the first sting, anesthetize the sore. If the patient is extremely sensitive and nervous, a 10-per-cent cocain solution may be used instead of the carbolic acid. Its action is no more effective.

5. After the whole surface of the ulcer has been fully whitened by the carbolic acid, dry again with blotting paper and apply, very cautiously, with another glass rod pure nitric acid.[1] Apply this in droplets until the whole surface is stained yellow or brown.

6. Wash again with peroxid and water and cover with calomel or nosophen.

Iodoform is by far the best dressing for chancroid, but its odor and reputation are prohibitive.

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[1] The actual cautery is preferred by some, but is too terrifying a sight for most patients.

If the first cauterization fails, it is futile to repeat it.

Palliative Treatment.—Since every uncomplicated chancroid tends to get well spontaneously, it may be treated expectantly, if cauterization is prohibited by the age of the lesion or the refusal of the patient.

The lesion must be kept mechanically clean and covered with some antiseptic. To do this, wash twice a day with peroxid and water and dust with calomel [1] (iodoform is still the best, but the most impossible application, and nosophen is the only one of its many "substitutes" that has given me any satisfaction). Never put grease on a chancroid. An occasional application of silver-stick or of pure carbolic acid stimulates the granulations. This minor cauterization should be repeated twice a week.

If the chancroid lies within the preputial cavity, cover it solely with the powder. If it lies outside, protect it from friction by a large pad of cotton held in place by a bandage or a bag.

Prevention of Bubo.—Warn the patient to avoid all violent exercise, and to walk about as little as possible in the hope of preventing suppurating bubo. Watch the groins carefully, and with the first sign of periadenitis (matting together of the glands) clap him into bed with a hot-water bag on his groin.

Do not, under any circumstances, paint the groin with iodin. It does no good and irritates the skin; so that, if the bubo does eventually suppurate and burst, the surrounding skin is ready for inoculation.

Treatment of Complications.—*Cellulitis and suppuration* call for wet dressings, rest in bed, elevation of the penis, and incision, *secundum artem.*

Phimosis, whether congenital or inflammatory, is the most annoying complication of chancroid. A chancroid under a tight foreskin, unless it can be aborted by early cauterization, demands prompt liberating incision.

After the chancroids have healed a secondary circumcision is usually required.

If the patient refuses operation, the best that can be done for him is to inject the preputial cavity with 10-per-cent argyrol solutions frequently—or, better still, refuse to treat him at all; for it is quite impossible to foretell what complications may ensue, and no physician can afford, even occasionally, to be responsible for a pathological amputation of the glans penis.

Above all things, do not pull back a tight prepuce. The *paraphimosis* which will probably result is not easy to reduce, and is the most fertile cause of gangrene.

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[1] Many efforts have been made to diminish the virulence of the bacteria by external applications of heat but without any great success.

Phagedena demands general anesthesia and extensive cauterization of every recess with the actual cautery, followed by wet dressings and iodoform. Do not fear to cauterize too much.

Delayed healing is the commonest and most annoying complication of chancroid outside the preputial cavity. To encourage healing, protect the sore with a voluminous dressing of cotton, and cauterize it once a week with nitrate of silver, applying in the meanwhile some stimulating lotion, such as red or black wash, or boric-acid ointment.

Partial erosion of the frenum forms a pocket which is very hard to clean. Tie a thread tightly around the remaining band, and it will cut through within forty-eight hours.

Suppurating bubo should be drained by very small incisions, almost punctures, multiple if need be, followed by injection of a 10-per-cent iodoform-in-vaselin ointment. Then apply wet dressings (or iodoform) topped by a hot-water bag. This injection is repeated every third day until the purulent discharge ceases. It almost invariably prevents chancroidal ulceration. If after several weeks the indurated masses of periadenitis show no tendency to decline they must be excised. (They will probably be found tubercular.) Usually the mass softens immediately and leaves a large chancroidal ulcer. The treatment of this is detailed above.

CHAPTER LXVII

THE INITIAL LESION OF SYPHILIS

The *initial lesion* (primary lesion) *of syphilis consists of the chancre and the adjacent adenitis.* It must not be forgotten that the inflamed lymph nodes form as essential and characteristic a part of the initial lesion as does the chancre itself.

THE CHANCRE

Synonyms.—Hard chancre, Hunterian chancre, indurated chancre, syphilitic chancre, primary sore.

Description.—The chancre is an eroded or ulcerated, painless neoplasm, arising at the site of syphilitic inoculation.

The chancre is primarily a neoplasm. By bearing this in mind we distinguish it instinctively from chancroid, which is primarily an ulcer. The one is a lump, the other a hole.

This neoplasm is commonly called the *induration.* This induration may be very extensive; it may form a large hard lump, projecting markedly above the surrounding tissues and having a diameter of perhaps an inch. But usually (in eight cases out of ten) it is small—one might almost say minute—and instead of projecting above the integument it is embedded in it. Thus, it may be felt rather than seen, and in appearance is rather insignificant than impressive.

The surface of this insignificant neoplasm is almost always eroded and moist, but it may be ulcerated, or it may be covered by an unbroken reddened integument.

Its *consistence* is *peculiarly hard and elastic,* as though a piece of cardboard were embedded in the integument. To appreciate this one must pick it up from the surrounding tissues and palpate it from side to side.

Pathology.—The chancre has the general characteristics of syphiloma. So brilliant a pathologist as Virchow said "chancre is but a gummatous ulcer." Accordingly, we find in a connective-tissue framework a mass of plasma cells, leukocytes, deformed epithelial cells—all the elements of an acute localized exudative inflammation. The vessels,

especially the arteries, are infiltrated, irregularly thickened, and occluded. The surface of growth is more or less neurotic, whence the erosion or ulceration. Proper staining shows an occasional spirocheta in the substance of the chancre.

FIG. 135.—LARGE ULCERATED HUNTERIAN CHANCRE. (Kaposi.)

This inflammation diminishes insensibly toward the border of the induration and extends into the surrounding tissue far beyond the apparent limits of the growth. The infiltrations in the vessel walls, in particular, extend beyond the palpable seat of the disease. Yet the depth of the chancre is almost nil. It occupies chiefly the epidermal layer of the skin, encroaching but little on the true derma and the subjacent tissue (Fig. 135).

Multiple Chancres. — The most striking characteristic of chancre is its insignificance; next in order of importance is its uniqueness. Yet too much stress may be laid upon this. The chancre is usually single, to be sure, yet Papagaey,[1] who collected 14,004 reported cases, found that in from 25 per cent to 33 per cent the chancres were multiple. This confirms other Continental statistics; yet multiple chancres are certainly much fewer in my practice. My records show only 56 among 549 cases examined—i. e., 1 in 10.[2]

But whether 1 in 10 or 1 in 3, the multiple chancre must be counted with, and *it is a grave clinical error to insist on the uniqueness of chancre as a diagnostic factor.*

The *number* of multiple chancres is 2 in 78 per cent of cases (Papagaey). My father has recorded 1 case of 11 and 1 of 12 chancres (4 on the left breast, 8 on the right). Fournier has seen a patient with 23 (7 on the left breast, 16 on the right).

The *location* of multiple chancres is almost exclusively genital. Only 2 per cent of extragenital chancres are multiple (Fournier). Chancres of the breast are quite frequently multiple.

The existence of multiple chancres brings up the question, When does syphilitic immunity begin? Is reinoculation possible?

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[1] *La syphilis*, 1906, vol. iv, p. 64.

[2] Other American authors agree that multiple chancres are relatively infrequent with us.

Although in many instances the several inoculations are indubitably simultaneous, in others they doubtless succeed one another, perhaps after an interval of several days. Indeed, Queyrat[1] has apparently proven that *it is sometimes possible to autoinoculate chancre* if the inoculation is performed before the lesion is ten days old, and experimental inoculation bears this out.

Yet, whether this be proven or not, clinically speaking, chancre is not autoinoculable. When the sore appears the whole man is poisoned and cannot be reinfected.

Types of Chancre.—The three chief types of chancre are:

1. The eroded chancre.
2. The ulcerated chancre.
3. The indurated papule.

The Eroded Chancre.—From 60 to 80 per cent of chancres assume this form. It is most characteristically exemplified by chancres within the preputial cavity.

The *induration* is rounded, *circumscribed,* and *thin,* sometimes so thin as to be scarcely perceptible except to the most delicate touch (parchment chancre).

Its *color* is usually a dark, vinous, or "raw-meat" red. Rarely it is of a dusty gray color (the color of lard). It may be covered with little petechiæ.

Its *surface* is usually flat. It may be a little elevated above the surrounding integument, or a trifle sunken below it, or surrounded by a slightly elevated ring of induration.

The eroded surface is smooth and polished. It emits a *slight seropurulent discharge.* It may be covered by a crust or a false membrane (from infection by skin cocci).

The Ulcerated Chancre.—This is the type of chancre described by Hunter, and to it the title "Hunterian chancre" is, therefore, peculiarly applicable. It is far less common than the eroded chancre.

It has a relatively large indurated base topped by a distinct ulcer. The ulcer is due to extensive necrosis, and the necrosis is proportional to the interference with circulation; thus the thinner induration forms an eroded chancre, while the more nodular mass ulcerates. Exceptionally, and doubtless on account of some unusual surface infection, the parchment chancre ulcerates deeply.

The ulcer extends into the true derma. Its edges are sloping (not undermined) and give the sore a sort of funnel shape; the base is granulating and may be covered by a false membrane; the discharge is slight and sero-sanguinolent.

The clinical picture of ulcerated chancre is that of a neoplasm eaten

[1] *Bull. de la soc. Franc., de derm. et de syph.*, 1906, vol. xvii, p. 66.

out by an ulcer, not that of an ulcer surrounded by an inflammatory ring. The neoplasm may be embedded within the skin; but pick it up, and you will realize that it is a distinct lump with an ulcer in the center.

The Indurated Papule.—This is the rarest type of chancre. It occurs usually in situations where the integument is so dense and thick as to prevent very extensive development of the neoplasm. The induration consequently remains a small, dark-red, flat papule. As it begins to heal the surface becomes scaly.

Exceptional Varieties.—The induration may be so slight as to be clinically imperceptible. Fournier noted this *absence of induration* 7 times in 300 cases.

As a result the lesion appears to be either:

1. A superficial herpetiform ulceration or group of ulcerations (herpetiform chancre), or

2. A grayish or silver-white spot of thickened epithelium. This is seen only on the glans penis.

Both these types are extremely rare.

On the other hand, the *induration* may be very *extensive,* and extend far beyond the ulceration. Its characteristics remain the same as those of the usual smaller varieties.

Complications of Chancre.—The chief complications of chancre are:

1. Lymphangitis and edema.
2. Chancroid (mixed sore).
3. Simple inflammation.
4. Phagedena (gangrene).
5. Transformation into a mucous papule.
6. Vegetations.

Lymphangitis.—The lymphangitis of chancre is by no means constant. Corded lymphatics, running from the chancre to the adjacent glands (e. g., along the dorsum of the penis), are not often seen.

But in certain localities, such as the prepuce and the labia majora, a great mass of lymphatic induration may surround the chancre, or small similar masses may lie adjacent. Such a complication obstructs the lymphatic flow and causes considerable edema. It is sometimes spoken of as indurative edema.

"Mixed" Sore.—As chancroid itself is rare among the upper classes, so is the mixed sore, the combination of chancroid and chancre. Among the chancres seen in the dispensary, however, fully one third are "mixed sores." A person may be infected with syphilis and with chancroid at the same time. In such a case the chancroid develops first, and a few weeks later becomes chancrous.

On the other hand, infection with chancroid may occur in the true chancre by subsequent inoculation.

Hence the possible combinations of chancre and chancroid are three;

1. The chancroid may appear, flourish, and be cured, and from its remains the chancre may arise.

2. The chancroid may overlap and overshadow the chancre, so that the latter is suspected only from the induration remaining after the sore heals, or proven by the appearance of secondary syphilitic lesions.

3. A true chancre may become chancroidal.

Of the three types, the second is the one commonly observed. The presence of chancre is not even suspected until the chancroid in healing begins to take on a suspicious hardness, or until a roseola breaks out all over the patient. *While the patient has an active chancroid, therefore, one can never assure him he has not true chancre.*

Inflamed Chancre.—The friction of clothes, or any other form of trauma, may so irritate the chancre that it becomes acutely inflamed; yet this is unusual. As a rule, the pyogenic microbes have no effect upon chancre beyond encouraging ulceration.

Gangrenous and Phagedenic Chancre.—The obstruction to circulation in the indurated base of a chancre is habitually sufficient to excite desquamation and exudation from its surface. Exceptionally, it is so marked as to cause *gangrene* of the dermis. Such a complication is of no great importance.

Phagedena is far rarer. Indeed, *the occurrence of phagedena is presumptive evidence that the sore is not chancre.* It is probably gumma or chancroid.

Transformation into a Mucous Papule.—Chancre upon the mucous membrane or between moist folds of skin may, at the time of the first, general, secondary outbreak, become a typical mucous papule. The fact requires no further comment.

Vegetations.—Soft warts may surround the chancre. Their presence is accidental, and can scarcely be called a complication.

Duration.—The chancre usually lasts four to six weeks, though some trace of induration may remain many months.

Reinduration of the chancre, which simply means recurrence of syphilitic inflammation (secondary or tertiary) in a chancre partially or wholly cicatrized, may prolong its duration indefinitely.

Fournier relates that he has seen a chancre run its whole course in two weeks. This must be about the minimum. Yet patients will often say that their chancres only lasted a few days, for they are careless observers. Their testimony merely bears witness to the clinical insignificance and painlessness of this lesion so fraught with grave consequences.

Diagnosis.—(See p. 719.)

Treatment.—If the chancre is not ulcerated a daily wash with warm water, protection from friction of the clothes, and the application of any simple dusting powder is all the treatment it needs.

If ulcerated, black wash (lotion nigra) is the customary application, and I know none better.

THE ADENITIS OF CHANCRE

Syphilitic inflammation of the group of lymph nodes adjacent to the chancre is part of the initial lesion. It is as constant and typical as the chancre itself. Indeed, Fournier failed to find it only thrice in 5,000 cases.

Inguinal adenitis may be bilateral or unilateral; if the latter, it is usually on the side corresponding to the chancre. Exceptionally the lymphatics so anastomose that the adenitis is on the opposite side (*crossed bubo*). As a rule, however, both sides are affected.

Symptoms.—The adenitis (bubo) appears in the second week after the appearance of the chancre, usually on or about the tenth day. It reaches maturity in two or three days, and presents the following characteristics: multiplicity, moderate size, absence of periadenitis and of all acute inflammation, hardness, slow resolution.

Multiplicity.—There is always a group of nodes involved; indeed, inguinal adenitis usually shows involvement of a group in each groin, but the one rather more enlarged than the other.

This group, or pleiad, as Ricord appropriately termed it, is made up of one (rarely more) large node surrounded by a group of lesser ones (clinically the large node often predominates the scene, the lesser ones being scarcely discernible).

Size.—The larger node scarcely attains the size of a cherry and may be much smaller; the lesser ones are the size of peas.

Absence of Inflammation.—Unless there is mixed infection the nodes are neither painful nor tender. They are freely movable beneath the skin, upon the subjacent parts, and upon one another.[1] The skin over them is not discolored; they do not suppurate. This *complete absence of periadenitis* is one of their most striking characteristics.

Hardness.—"The hardness of the nodes is the hardness of the chancre"; such is the routine statement. The clinical facts do not quite bear it out. Though the nodes may be as hard as the chancre, and when so are typical, in the larger number of cases they are distinctly more elastic.

Slow Resolution.—The great virtue of syphilitic bubo is that it persists many weeks after the chancre has disappeared and may lead to the discovery of the scar of a healed chancre. It usually persists three months.

Unusual Varieties. — The bubo may be abnormal, inflamed, or "mixed."

[1] Unless they are greatly inflamed, in which case they adhere tightly to one another.

Abnormal Bubo.—Exceptionally the bubo consists of a single very large gland, or the large gland is altogether lacking.

Inflamed Bubo.—Inflamed bubo is much more common than inflamed chancre. The pyogenic bacteria multiply upon the chancre and from it enter the lymph current, yet may not cause much local irritation. The common clinical causes of inflamed bubo are genital filth and cohabitation.

The bubo of labial or buccal chancre is habitually a large, tender, inflamed mass.

"Mixed" Bubo.—Syphilitic adenitis may be complicated by chancroid or by tuberculosis.

Chancroid and chancre combine to make a "mixed" sore and a "mixed" bubo. In both instances the characteristics of the chancroid lesion overshadow the other.

Tuberculo-syphilitic nodes I have never seen. They are said to assume the tubercular type.

Diagnosis.—The typical group of one large uninflamed gland surrounded by a lot of little ones—all of them hard, insensitive, and not adherent—is so unmistakable that a discussion of its differentiating characteristics is all but superfluous.

Certain varieties of herpes or balanitis excite a bubo quite similar to that of syphilis; but the exciting lesion is so dissimilar that a mistake is scarcely possible.

The insensitive, hard, movable nodes of syphilis can scarcely be confused with the inflamed, tender, adherent nodes of chancroid; though, as we have already said, the latter may conceal the former.

The bubo is readily diagnosed and forms, as we shall see, one of the most important means of diagnosing chancre.

Treatment.—Neither demanded nor available.

Diagnostic Table of Genital Sores

SYPHILITIC CHANCRE	CHANCROID	HERPES	SCABIES	GUMMA
1. — *History.* —Sexual contact, kissing, mediate infection, vaccination, etc.	1. Sexual contact.	1. Relapsing herpes.	1. The family scratches.	1. Syphilitic.
2. *Incubation.* —Two to six weeks.	2. Three to seven days.	2. None.	2. None.	2. None.
3. *Microscope shows.* — Spirocheta often.	3. Streptobacillus, not always.	3. Nothing characteristic.	3. Nothing characteristic.	3. Nothing characteristic.

SYPHILITIC CHANCRE	CHANCROID	HERPES	SCABIES	GUMMA
4. *Autoinoculability.* — Uncertain and atypical.	4. Produces typical chancroid on third day. From this streptobacillus may be readily obtained.	4. No.	4. Produces a cuniculus, perhaps.	4. No.
5. *Commencement.* — Begins as an erosion or a papule, and remains an erosion or ulcerates.	5. Begins as a pustule or ulcer, and invariably remains as an ulcer.	5. Begins as a group of vesicles, rarely as a single vesicle, and becomes an ulcer.	5. Begins as a papule; becomes ecthymatous.	5. Begins as a tumor which ulcerates later.
6. *Number.* — Usually unique or simultaneously multiple; rarely multiple by successive autoinoculation; never confluent.	6. Usually multiple, both simultaneously and by successive autoinoculation; often confluent.	6. Usually multiple; simultaneously and by successive crops of vesicles; sometimes confluent.	6. Usually multiple and scattered over the body. Not confluent.	6. Usually single. Confluent if multiple.
7. *Physiognomy.* — (*a*) Shape: round, oval, or symmetrically irregular.	7. (*a*) Shape: round, oval, or unsymmetrically irregular with border described by segments of large circles.	7. (*a*) Shape: irregularly rounded, with borders described by segments of small circles left by the confluent vesicles.	7. (*a*) Shape: round or oval.	7. (*a*) Like chancre.
(*b*) Lesion is habitually flat, capped by erosion or superficial ulceration; or scooped out; or a deep, funnel-shaped ulcer with sloping edges. Sometimes the papule is dry and scaly.	(*b*) Always a true ulcer, excavated, hollowed out.	(*b*) Ulcer usually superficial; sometimes in solitary herpes there is but one absolutely circular vesicle. There are usually neighboring groups of vesicles to clear up the diagnosis.	(*b*) Ulceration slight. Ecthymatous.	(*b*) Like chancre.

SYPHILITIC CHANCRE	CHANCROID	HERPES	SCABIES	GUMMA
(*c*) Edges: sloping and adherent, sometimes prominently elevated.	(*c*) Edges: sharply cut, abrupt, often undermined.	(*c*) Edges: sharp, not undermined.	(*c*) Edges: like herpes.	(*c*) Edges: like chancre.
(*d*) Bottom: smooth, shining.	(*d*) Bottom: uneven, warty, irregular, without luster.	(*d*) Bottom: even, inflammatory.	(*d*) Like herpes.	(*d*) Like chancre.
(*e*) Color: somber, darkish red, gray, or black; sometimes livid and scaly, occasionally scabbed.	(*e*) Color: yellow, tawny, false-membranous-looking; sometimes bright.	(*e*) Like chancre.	(*e*) Like ecthyma.	(*e*) Like chancre.
(*f*) Secretion: slight, sero-sanguinolent, unless irritation provokes suppuration.	(*f*) Secretion: abundant and purulent.	(*f*) Secretion: slight, sero-purulent.	(*f*) Secretion: very slight.	(*f*) Like chancre.
8. *Induration.*—Constant, parchmentlike and very faint, or cartilaginous and extensive, terminating abruptly, not shading off into parts around, movable upon parts beneath the skin, and not adherent to the latter: may disappear in a few days, usually outlasts the sore and may remain for months.	8. Absent in typical cases. An induration may be caused by irritants or by inflammation. It is boggy, not elastic, shades off into surrounding tissues, is adherent to parts around, disappears promptly on healing of the sore, or before that time.	8. Inflammatory induration, capable of being produced by the same causes as in chancroid, and behaving in a precisely similar manner.	8. Same as herpes.	8. Same as chancre. Induration always extensive.
9. *Sensitiveness.*—Absent.	9. Painful and sensitive.	9. Beginning heat.	9. Itch.	9. Absent.

SYPHILITIC CHANCRE	CHANCROID	HERPES	SCABIES	GUMMA
10. *Duration.*—At least a fortnight.	10. Varies from a few days to many weeks.	10. Rarely more than ten days.	10. Indefinite.	10. At least a fortnight. Usually much longer.
11. *Phagedena.*—Extremely rare.	11. Rare.	11. No.	11. No.	11. Uncommon.
12. *Lymphangitis.*—Syphilitic.	12. Inflammatory.	12. Same.	12. None.	12. None.
13. *Lymphadenitis.*—Syphilitic, constant.	13. Chancroidal; or inflammatory in one third of all cases.	13. Rare, inflammatory.	13. None.	13. None.

The final test is the advent of secondary symptoms.

CHAPTER LXVIII

THE GENERAL CHARACTERISTICS OF SYPHILIS

Syphilis (the pox) is an infectious disease caused by the Spirocheta pallida. It is acquired by contagion or by heredity; it is chronic in course, indefinite in duration, essentially intermittent in character, manifesting itself by a succession of lesions which may involve any part of the body, and which are arbitrarily classified as primary, secondary, tertiary, and parasyphilitic.[1]

Syphilis is as varied in character as it is widespread in distribution. No country in the world, no organ in the body is exempt from its taint. It shortens more lives than we can estimate, and its ultimate ravages are not yet known.

ACQUIRED SYPHILIS

The general characteristics of syphilis are best studied in its "acquired" form. The peculiarities of hereditary syphilis may be subsequently discussed.

The disease may be acquired only by contact with a syphilitic sore or with some substance upon which the secretion of a syphilitic lesion has been recently deposited. The infection does not travel in the air, nor do rooms occupied by syphilitics become infected. Moreover, the virus is probably incapable of piercing the intact integument.

The Primary Lesion.—Acquired syphilis always begins, after a few weeks' incubation, with an eroded papule at the point of inoculation. This lesion is called chancre, and is accompanied by a characteristic inflammation in the adjacent lymph glands. This chancre and adenitis constitute the *primary lesion.*

The Secondary Lesions.—A few weeks later the secondary lesions appear. These consist of typical exanthemata upon the skin and mucous membranes, acute inflammations of certain organs (iritis, periostitis, etc.), and evidences of general infection. The toxemia is often very light and generally lasts but a few weeks, while the localized secondary

[1] The classification of late sclerotic lesions as quaternary has been suggested, but is not generally accepted.

lesions have a tendency to relapse, after intervals of apparent health, for at least two years. These localized secondary lesions are infectious, superficial, and benign (i. e., tending to spontaneous cure, and generally speaking, not destructive of tissue nor productive of a permanent scar.

The Tertiary Lesions.—The tertiary lesions of syphilis may occur at any time after the appearance of the chancre. They may relapse after an interval of years. They rarely appear until after the first outbreak of secondary lesions has spent itself. In contrast to the secondary lesions they are clinically not infectious, are deep rather than superficial in location and malignant in that they destroy tissue and show little or no tendency to spontaneous cure. Moreover, they bear no special affinity to the skin, but impartially attack every organ. Histologically the tertiary lesion is either a specific syphilitic granuloma (gumma) or a diffuse interstitial sclerosis.

The Parasyphilides.—Finally, there is a class of lesions, partially syphilitic in character, termed by Fournier the parasyphilides. These lesions occur usually in persons who have had syphilis, but after the other syphilitic lesions have ceased to appear. Yet they also occur in persons who are not apparently syphilitic; they are often entirely unmanageable by mercury and iodids (the antisyphilitic specifics) and, even when occurring in syphilitics, they are habitually in part due to other causes.

Thus the exact nature of the parasyphilides is not clear. Some of them, such as tabes, are almost exclusively due to syphilis; others, such as arterial sclerosis, are far from being exclusively syphilitic; while in all, the absence of lesions pathologically syphilitic as well as the resistance to antisyphilitic treatment render a decision still more doubtful.

Are there Periods of Syphilis?—The above classification is an arbitrary one. The primary lesion is definite and immutable (though it may be overlooked), but beyond this all is variable. Secondary lesions may be so mild as to pass unnoticed. Tertiary lesions may never occur, or they may appear before the secondary, or the two may exist side by side or, more confusing still, a given lesion may be on the border line, perhaps secondary, perhaps tertiary; and a superficial lesion, apparently secondary at first, may later develop the characteristics of tertiarism. Moreover, parasyphilitic lesions may coexist with tertiary manifestations.

Hence there is no such thing as a purely secondary or tertiary period of the disease. Secondary symptoms; yes. Tertiary symptoms; yes. Periods; no. The terms secondary and tertiary are conventional symbols to express the quality of certain symptoms. It is utterly misleading to apply them to periods of time when these periods so overlap as to

produce confusion from the use of terms whose only purpose is to prevent confusion.

Transmission of Syphilis

Recent experimental investigations upon monkeys have confirmed in large measure the accepted theories of syphilitic infection.

We have learned that the spirocheta is the infectious agent, and that infection is most common from the chancre and the secondary lesions. But, inasmuch as rather intimate contact with the secretions of a syphilitic lesion is essential to infection, it is probable that of the secondary lesions only the moist papules and ulcers are clinically infectious. Dry secondary lesions, as well as all tertiary lesions, do not transmit the spirocheta even though they contain it. They are not infectious.

There has always been question, however, of the virulence of the secretions of the syphilitic, notably his semen, and also of the virulence of his blood, notably in reference to surgical operations. That the secretions may be virulent is proven by the discovery of spirocheta in the nares (Levaditi), on the conjunctiva (Bab), in the epithelium of the bowel and of the kidney in hereditary syphilis, while a monkey has been infected by the apparently normal semen of a syphilitic man.

Whether in each of these instances some minute syphilitic lesion was present and accounted for the exudation of spirochetæ is a purely academic question. The clinical fact remains that the overwhelming infection of severe hereditary syphilis may produce an infectiousness of all the apparently normal secretions; while in acquired syphilis the apparently normal semen may be infectious.

That infection from such sources must be rare, however, is shown by the numerous failures of inoculations made with mothers' milk, with urine, with semen, etc.; and the danger of such infection is probably extremely small unless from the prolonged contact possible in seminal transmission.

The danger of infection from syphilitic blood is even slighter. The spirochetæ are few in the blood and are present only in the most fluid stage of the disease. The real danger of infection with syphilis lies in the mucous ulcer or papule, which may exist unsuspected and even undiscoverable about the mouth or genitals, though its infectiousness is undiminished by its insignificant size.

Whether, as has been alleged, a clean woman may act as an intermediary host and convey the virus from a syphilitic partner to a clean one, and yet escape infection herself, would be hard to prove, though such an accident is eminently possible. Sexual contact with a person supposed to be clean is surely often the occasion of a syphilitic infection; less often the infection is extragenital and nonsexual.

Extragenital and Nonsexual Infection

Though syphilis occurs in all lands and at all ages, it is relatively much more common in some countries than in others. Thus in some of the Balkan states and in certain parts of Russia and Asia Minor, in many tropical countries, and in certain isolated communities, syphilis is practically endemic. Everyone has the disease, and it is transmitted fully as commonly by extragenital as by genital contact. In the United States, however, the disease, though universally distributed, probably affects a smaller proportion of the community than in most countries; and, inasmuch as we do not indulge in kissing and other forms of personal endearment so much as our European neighbors, extragenital infections are relatively uncommon among us.

Among some 2,200 syphilitic men I find but 70 instances of extragenital chancre; while among 207 syphilitic women, 21 showed or gave history of extragenital chancre. This proportion—about 3.5 per cent for men and 10 per cent for women [1]—confirms the accepted belief that women are more often innocently contaminated than men, while the method of contamination is sufficiently indicated by the following table, in which practically all chancres of lip, tongue, and tonsil were due to kissing, while almost all the finger chancres in men occurred in doctors and were due to vaginal examination, only one of them being attributed to infection during a surgical operation. The breast chancres were acquired by nursing syphilitic infants. A chancre of tongue or tonsil may surely be acquired by simple lip contact with an infected surface, just as urethral chancre may result from normal coitus.

Extragenital Chancre

TABLE I

Male	70 cases	*Female*	21 cases
Finger	34 "	Lip	13 "
Lip	24 "	Finger	2 "
Tongue	4 "	Vaccination	2 "
Tonsil	2 "	Breast	2 "
Abdomen	2 "	Tonsil	1 case
Cheek	1 case	Eyelid	1 "
Chin	1 "		
Eyelid	1 "		
Arm	1 "		

Although the disease may only be transmitted by inoculation of the secretions from the primary or secondary lesions, and although, theo-

[1] Fournier has tabulated 10,000 chancres (96 per cent of them in men), of which 94 per cent were genital in man and only 63 per cent in women.—They kiss everyone in France.

retically at least, the possession of an unbroken integument protects from danger of infection with syphilis, one can never be absolutely sure that a patient in the first two or three years of syphilis has not some insignificant lesion of mouth or genitals whose presence he does not realize, nor can one be sure of an absolutely unbroken integument. It cannot be too often repeated—syphilis is frequently transmitted by a person who believes he has no lesions of syphilis upon him to a person who believes his integument intact.

Does Exposure Necessarily Imply Infection?—No; emphatically not. The physician who has the confidence of his patients will occasionally come upon cases where exposure, even repeated exposure, has not resulted in infection.

The following set of cases related to me by Dr. John F. Connors may serve as an example: Eleven men were repeatedly and in rotation exposed to infection from a single woman. They thought themselves well and she was not obviously diseased. Yet 6 of them contracted gonorrhea and chancroid, 4 syphilis and chancroid, and 1 chancroid alone. Total, chancroid, 100 per cent; gonorrhea, 55 per cent; syphilis, 36 per cent.

When Does Syphilis Cease to be Infectious?—Since the probabilities are so vague, what are the possibilities? The question is by no means easy to answer. Certainly 8 out of 10 syphilitics cease to be infectious within three years. Certainly 99 men out of 100 cease to be infectious within four years. Certainly the proportion of infections from syphilitics of more than five years' standing is infinitesimal, and if the patient, at the end of the fifth year of his disease, has been two years without symptoms or treatment, he may be guaranteed for matrimony, though against (noninfectious) relapses in his own person he may never be wholly guaranteed.

SYPHILIS AND MARRIAGE

The danger of marital infection is instant, and the chances for it are at least 12 to 1 during the first year of the disease, 5 to 2 in the second year, 1 to 4 in the third year, and all but nothing after the fourth year—whether the patient has been well treated or not.

Most practitioners are willing to assure their patients that after three years of treatment all danger of transmitting the disease is past. Yet this is by no means an absolute rule. Though none of my cases of late infection was derived from patients who had been well treated, there are many such recorded. Tarnowsky has reported [1] the transmission of syphilis in the fifth, sixth, ninth, tenth, and fifteenth years.

[1] *Third Internat. Congress of Dermatology*, 1896.

Neumann [1] accepts the possibility of contagion between the fifth and the tenth year, and perhaps later. Fournier relates 3 infections during the sixth year, 1 in the seventh, 6 in the eighth, 3 in the ninth, 2 in the tenth; but at this point even Fournier falters. He relates cases of supposed infection at the end of twelve, thirteen, and seventeen years; but confesses that "in view of the complexity of the subject and the great possibility of error in so delicate a matter, these cases are as yet too few to warrant any conclusion being drawn from them."

But Fournier is an extremist. He stands almost alone in his horror of late infections. Twenty years ago he acquiesced in matrimony at the end of five years of syphilis; to-day he says: "If my son contracted syphilis, I should not permit him to marry before the sixth or seventh year of the disease." [2] We can afford to be a little milder and assert that matrimony is often safe and sometimes justifiable at the end of three years, but unless the social elements at stake are very great it is more prudent to follow the rule that *marriage of a syphilitic is permissible only after five years, during the last two of which he has been without symptoms and without treatment.* The occurrence of symptoms, especially if they be secondary symptoms, after the third year of the disease should postpone matrimony until two years have elapsed since the termination of the treatment required to cure these symptoms.

The reason for requiring two years of health is this: Late infections, like early ones, are due practically always to contamination by secondary lesions in the mouth and upon the genitals. Of the 18 cases related by Fournier in which infection occurred between the sixth and seventeenth years of the disease, 10 were buccal and 8 genital infections. Now these lesions are likely to relapse persistently and without long intervals of health.[3] Consequently, the lapse of two years without such lesions is a sufficient guarantee that they will not recur. If the patient is an inveterate smoker, he should be warned of the danger of relapsing lesions of the tongue to which his habit subjects him. Curiously enough, several patients had been repeatedly warned of this danger before they succeeded in infecting their wives.

Finally, let it be remembered, the moral aspect of this question must carry fully as much weight as the physical. To prohibit matrimony in a given case may wreck a man's life even more completely than syphilis could blast his wife's, and though this consideration can have no force in the first two years of the disease when infection is all but certain, in the fourth and fifth years one may make exceptions for adequate social cause and with due precautions, deeming the possibility of infection

[1] *Wien med. Presse,* 1899.

[2] *Bull. de la soc. franc. de prophylaxie san. et mor.,* 1906, v. 125.

[3] Whereas tertiary noncontagious lesions often relapse after many years of health.

light in comparison to the certain despair implied by delay. After the fifth year it is wiser even to urge matrimony, for nothing so completely disarms syphilis of its terrors as the possession of a calm fireside, a happy wife, and a ruddy child. Many a man has been driven to this happiness like a whipped cur, and has found in it a fullness of content which the medicines and maxims of no physician could provide.

HEREDITARY SYPHILIS

The laws that govern the inheritance of syphilis are not well understood, lacking as they do any scientific control and depending entirely upon clinical facts.

A syphilitic father may beget a syphilitic child without apparently infecting the mother; yet this mother cannot be infected with syphilis by nursing the child (Colles's law), although the child will promptly infect any other wet nurse. Moreover, the mother of such a syphilitic child, although herself remaining healthy many years, almost invariably ultimately breaks out with tertiary syphilis (*choc en retour*). Manifestly, therefore, the mother of a syphilitic child, even though she remain apparently sound, is syphilitic.

The danger of transmission from father to child ceases in from two to five years if the father is properly treated. Under inefficient treatment paternal virulence may last indefinitely, though it is likely to terminate within five years in any case.

The danger of transmission from mother to child does not, however, terminate at any definite time. Some mothers continue to bear syphilitic children for years after the disappearance of their own symptoms. That such cases are exceptional does not lessen their importance.

And the child itself. It may die *in utero* and be expelled as a fetid disorganized mass. It may be born to live but a few days. It may reach maturity, bearing in mind and body the scars of its parent's misfortune. It may remain well many years only to fall victim to an unsuspected "delayed hereditary syphilis." It may not be infected. Freaks of fortune and effects of treatment ring every possible change. Of twins even, one may be born healthy, the other syphilitic. But, generally speaking, the infection lessens with each succeeding conception. Thus, when a man in the infectious stage of syphilis marries, the first product of conception usually dies *in utero,* and miscarriage of a deformed, macerated fetus ensues. After one or more such mishaps a child is born, cachetic, perhaps actively syphilitic at birth or soon showing evidences of the disease. Such children usually die promptly. Later children are born which show no signs of the disease at first, and may either remain well or show certain stigmata of syphilitic heredity, or become actively syphilitic.

Hereditary syphilis is the same disease as acquired syphilis. But its lesions are modified by the undeveloped condition of the organism attacked as well as by the mode of infection. Whether the fetus is infected by father or by mother (the theories upon this subject will be discussed later), there cannot be said to be any port of entry for the virus (unless it be the placenta); hence there is no chancre, no primary lesion.

The secondary infectious lesions are sometimes skipped (or overlooked) in hereditary syphilis, and the so-called delayed hereditary syphilis is always tertiary in type.

But the overshadowing features of hereditary syphilis are the virulence with which it overwhelms the infant and the characteristic developmental deformities it imparts, deformities especially of the teeth, the cranium, and the remainder of the skeleton. These are called the syphilitic dystrophies.

Hereditary Syphilis of the Third Generation

In face of a general agreement of authorities as to principles, and in spite of the divergent interpretation of details, one must at least confess that hereditary syphilis in the third generation is possible, though it must be eminently rare. And one may add by way of precaution that the other factors in heredity—especially in the production of congenital dystrophies, such as alcohol, privation, etc., whose influence is so marked upon syphilis in the first and second generation—must be important elements, and are perhaps even *the* important elements in determining syphilitic heredity—especially dystrophic heredity—in the third generation.

THE SECOND ATTACK OF SYPHILIS

In a recorded office experience of over 2,000 cases of syphilis and an unrecorded hospital experience of far more than as many again, neither my father nor I have encountered an authentic case of a second attack of syphilis. Our experience, therefore, convinces us that a single attack of syphilis confers immunity that lasts an ordinary lifetime. It were, however, quite as absurd to insist that this immunity must last a lifetime as to insist that syphilis is incurable. All that one can safely allege is that there is only an infinitesimal danger of error in assuring one's patients that syphilis boasts a solitary virtue—viz., having acquired it once they will never acquire it again.

CHAPTER LXIX

ETIOLOGY AND PATHOLOGY OF SYPHILIS

In May, 1905, Schaudinn and Hoffmann, while endeavoring to identify the Cytorrhyctes luis (Siegel), one of the alleged causes of syphilis, observed a hitherto undescribed organism in the secretions from syphilitic sores. The publication of their findings was immediately followed by confirmatory evidence from all parts of the world. Metchnikoff and Roux not only confirmed the observation, but called attention to the fact that Bordet and Gengon had previously observed the microörganism in certain syphilitic secretions, but not finding it constantly, had dropped further investigation. Levaditi found it in lesions of congenital syphilis. Bertarelli, Volpino, and Bovero were able to identify it in stained sections of syphilitic organs. Larrier and Bergeron have recently identified it in the blood of syphilitic patients, and innumerable observers in every country have noted clinically that the organism may be found in almost every lesion of early untreated syphilis, though most common in the most infectious lesions.

So overwhelming indeed is the mass of evidence that, in spite of the fact that the organism has not been cultivated, it seems certain that the cause of syphilis has at last been found, and we may safely say that the spirocheta of Schaudinn is either the cause of syphilis or one phase in the life cycle of some microörganism which is the cause of syphilis.

THE SPIROCHETA PALLIDA

The Spirocheta pallida (spironema, treponema [1] pallidum) is a motile spiral organism (Fig. 136), varying in length from 4 to 14 μ, in diameter from an immeasurable thinness up to about $\frac{1}{4}$ μ; it is cylindrical, not flattened; its spirals usually number from 6 to 14, though as high as 20 and 25 have been counted in exceptionally long ones. The length and depth of the spirals varies from 1 to 1.5 μ.

[1] The name "treponema" was suggested by Schaudinn as more accurately descriptive of the exact nature of the parasite. But this name has met with no general favor and the special features upon which Schaudinn based his preference are still contested. Indeed, so little is yet known about the spirochetæ, that it is impossible to place them

Whether in motion or at rest, alive or dead, the Spirocheta pallida never loses its spiral shape.

Methods of Staining.—The Spirocheta pallida approximates the protozoa in its resistance to the usual bacterial stains.

For the examination of fluid specimens the *dark-field illumination* should, therefore, always be employed, for in the dark field the characteristic shape and motion of the Spirocheta pallida distinguish it clearly from all similar organisms. The classic method of preparing and staining is *Schaudinn and Hoffmann's modification of Giemsa*, as follows:

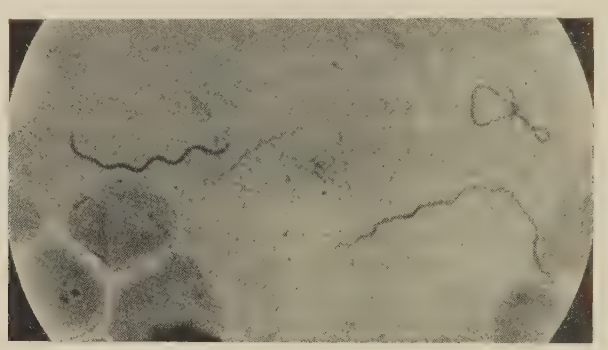

Fig. 136.—Spirocheta Pallida (two in center) and refringens (three, more deeply stained.) (Hoffmann.)

1. Obtain the specimen by scratching the surface of the lesion (chancre, mucous patch), after having washed it thoroughly clean of all contamination [1]—the admixture of a trace of blood does no harm. Spread the secretion thus obtained as thin as possible; *dry without heating;* harden for fifteen minutes in absolute alcohol.

2. Employing the Giemsa stain (made by Grübler, of Leipzig), dilute this by adding about 1 drop to 1 c.c. of water (to which 1 to 10

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as a class, still less to determine accurately the relative positions of individual members of that class.

Whether Spirocheta pallida is a bacterium or a protozoön, whether it divides by longitudinal or by transverse fission, whether its flagella are real, whether it has an undulating membrane and nuclei, the future must decide.

The most recent contributions summing up our present knowledge of Spirocheta pallida are: Sobernheim, *Handb. d. Path. Microorg.*, 1907, No. 2, p. 527 (with eleven pages of bibliography); and in American literature, Rosenberger, *Am. Jour. Med. Sci.*, 1906, vol. cxxxi, p. 143; Pfender, *Am. Med.*, 1906, vol. xi, p. 350; and Ewing, *N. Y. State Jour. of Med.*, 1907, vol. vii, p. 177.

[1] Rille and Vockerodt found that antiseptic wet dressings eliminate mixed infection without affecting the spirochetæ. Inasmuch as the spirochetæ lie among the epithelia rather than upon them, the best results are obtained by scraping the lesion quite deeply. The fewer leukocytes in the exudate the more spirochetæ it is likely to contain (Ewing).

drops of 1:1,000 calcium carbonate has been previously added—this is advantageous but not essential).

3. Immediately spread the diluted stain on the specimen and let it stand one hour.

4. Wash freely in water, dry without heating, and mount.

This is the standard stain. A quicker method is that of Simonelli and Bandi [1] or of Goldhorn.[2] A few drops of this will stain a specimen (dried without heating) in two or three seconds. The smear is then rinsed in water and dried (cold).

Tissue Stain.—The best is Levaditi's modification of the Ramon y Cajal silver stain.[3]

1. Sections are cut 1 mm. thick and hardened in 10-per-cent formalin for twenty-four hours.

2. Wash and harden in 96-per-cent alcohol twenty-four hours.

3. Wash a few minutes in water until they sink.

4. Impregnate with silver by soaking for three (to five) days in a 1.5-per-cent (to 3-per-cent) solution of silver nitrate at a temperature of 38° C.

5. Wash rapidly in water and place for twenty-four (to forty-eight) hours at the room temperature in

Acid pyrogallic	2 gm.;
Formalin	5 c.c.;
Aq. destill.	100 c.c.

Distribution.—Sufficiently expert and conscientious investigation reveals Spirocheta pallida in fully three fourths of the smears taken from chancres, moist papules, and mouth lesions.

It was to be hoped that aspiration of the lymph nodes adjacent to the chancre might prove a simple means of obtaining uncontaminated smears of Spirocheta pallida; but, unfortunately, the microörganism is rare in the center of nodes, being chiefly confined to the region of the periphery, so that there is a distinctly less probability of finding them there than in the chancre itself.

Though the later secondary lesions contain fewer spirochetæ, these have been found as late as nine years after chancre by Sobernheim and Tomasczewski.

They have been found in the pus from a nonsyphilitic abscess occurring during the acute stage of the disease (Flügel), in the serum of blisters raised by cantharides (Levaditi and Petresco), in albuminous

[1] *Centralbl. f. Bact., Parasit. v. Infect.*, 1905, vol. xl, p. 159.

[2] *Jour. of Exper. Med.*, 1906, vol. viii, p. 451.

[3] The so-called old Levaditi, in contradistinction to the new or pyridin Levaditi, which is quicker but not so accurate.

urine (Dreyer and Toepel), in the blood—after many failures, and only during the first few months and before the beginning of mercurial treatment (Nöggerath and Stähelin, Schaudinn, Richards and Hunt *et al.*).

Most interesting of all has been the search for *spirochetæ in tertiary lesions,* which, for a long time, was fruitless, but was finally crowned with success. Tomasczewski, who has found them in 5 out of 10 gummata examined, states that eight to ten hours must sometimes be spent in examining smears before finding a typical spirocheta.

The moist lesions of early hereditary syphilis swarm with spirochetæ, and they have been found (either in smears or in sections) in practically all the organs of still-born syphilitic infants—viz., liver, lung, spleen, kidney, suprarenal muscle, heart, stomach, intestine, mesenteric glands, gall-bladder and ducts, ovary, uterus, prostate, testis, urinary bladder, thymus, tonsil, bone, joint, etc. They are usually most numerous in the liver, lungs, and skin. They have been found in both fetal and maternal placenta, and once in the inguinal glands of the apparently healthy mother of a syphilitic child (Buschke and Fischer)! Curiously enough, masses of spirochetæ are sometimes found in and about the capillaries where no tissue change has taken place.

They have not been found in the cerebro-spinal fluid, though they doubtless will be, for positive inoculations have been obtained upon monkeys with this fluid (Hoffmann).

The examination of normal secretions—except the semen—is always negative, except in severe congenital syphilis (p. 725). Whether the exception in the case of semen is due to syphilitic lesions in the seminal canals it is impossible as yet to say.

Fate.—Though spirochetæ have been kept alive for a few days on artificial media, none of the attempts at artificial cultivation have thus far been successful.[1]

Spirochetæ are found most frequently in the earliest and most infectious lesions of syphilis. Whether in the chancre and early secondary lesions of acquired syphilis or in the organs in inherited syphilis, they abound in the walls of the blood-vessels and in the perivascular tissues. They are relatively rare in the lymph vessels, surprisingly few in the nodes, and when found in the nodes are usually in or about the blood capillaries at their circumference (Hoffmann and Beer). They have been found in great numbers among the epithelia of the chancre or the moist papule. A few observers believe they have seen evidence that the spirochetæ are destroyed by phagocytosis. In tertiary lesions (gummata) they have been found only in the active, advancing edge of the lesion, never in its necrotic center or in its secretion.

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[1] Spirocheta refringens has been cultivated by Levaditi; Spirocheta obermeieri by Novy.

It seems probable, therefore, that the spirochetæ are distributed by the lymph rather than by the blood current, directly excite the perivascular inflammation characteristic of all syphilitic lesions, and are destroyed by phagocytosis.

Although a few observers have denied that the administration of mercury has any effect upon the spirocheta, it is the consensus of opinion that, as soon as mercury is administered, the spirochetæ rapidly disappear and soon are undiscoverable, and this disappearance seems to be especially rapid under inunction and hypodermic medication.

EXPERIMENTAL SYPHILIS

Much work has been done in this line by the distinguished chiefs of the Institut Pasteur at Paris, by Neisser, who made a special trip to the tropics for this purpose, and by others. These investigators have proven beyond possible doubt that monkeys may be infected with syphilis, and have even worked out the type of simian syphilis.

In other animals successful inoculations have been made; but the resultant syphilis is a travesty on the dire disease we know. Thus Bertarelli, Hoffmann, and Scherber have inoculated the corneas of bitches and produced a localized typical syphilitic inflammation from which spirochetæ could be obtained. But such investigations are of no practical import.

But the most important practical conclusion yet reached from these experiments is that *syphilitic secretions cease to be infectious after twelve to twenty-four hours, and much sooner (at most six hours) when dry.* This explains why we are not all infected by cigars and why the syphilitic may live and dine with his family in absolute safety so long as the cups, forks, and spoons that enter his mouth are washed and dried before being used by anyone else at the following meal.

Prophylaxis.—As soon as Metschnikoff and Roux had proved to their satisfaction the transmissibility of syphilis to monkeys, they turned their attention to its prophylaxis. The results of their experiments were startling. They found that *excision of chancre, even of commencing chancre, is entirely futile as a preventive or minimizer of the subsequent development of the disease.* Cauterization of the chancre they found equally futile. Indeed, *wide excision of the inoculated area at any time later than eight hours after inoculation failed to prevent the development of chancre* [1] (confirmed by Neisser). Moreover, the application of heat to the site of inoculation (to destroy the virus) and of various antiseptics (including strong solutions of sublimate) availed nothing.

[1] But in one case amputation of an inoculated ear after twenty-four hours was preventive, and the monkey was subsequently successfully inoculated.

The only way in which they were able to destroy the virus after inoculation was by applying, within six hours, a calomel salve (calomel, 20; lanolin, 40). So universally preventive did this prove that they performed a confirmatory inoculation (with monkey controls) upon a medical student, inoculating him with the virulent secretion of a chancre and of a mucous papule, rubbing in the calomel salve within one hour, and watching him long enough to be sure that no sign of syphilis developed.

Hence we may infer that *the only personal prophylaxis against syphilitic infection lies,* not in cauterization or excision, but *in inunction with a strong mercurial ointment within one hour* [1] *of inoculation.*

Inoculation Immunity.—All efforts to develop artificially either an active or a passive immunity to syphilis have failed in man as well as in monkey. Taking as a starting point the immunity to reinfection, which begins so early in the disease (tenth to fourteenth day), and usually lasts a lifetime, inoculation experiments have been made with the blood serum of syphilitics, with the juices from syphilitic lesions (filtered through porcelain), as well as by "passing" the infection through several individuals. The result has been absolute zero: as yet "the only way to be immune to syphilis is to have it."

Serum Diagnosis and Treatment.—In this line lie our brightest hopes for practical results from animal inoculation. Imagine what would become of syphilis on the discovery of a diagnostic chemico-physiologic test and of a therapeutic serum! The promise that some such sera may soon be obtained is almost too good to believe.

Among the proposed diagnostic serum tests those of Wassermann and of Noguchi are the best known. Both are of value in the diagnosis of *active untreated* syphilitic lesions. If the patient has taken no mercury whatever for three months, and suffers from symptoms the nature of which is not clear, the test is almost invariably accurate and may be of great assistance in making a diagnosis. But if mercury has been recently administered the test is valueless if negative, and if the syphilis is in a period of seeming calm a negative Wassermann has little or no prognostic value.

The proper interpretation of these tests requires great care and much experience.

PATHOLOGY OF SYPHILIS

Syphilis is apparently caused by the Spirocheta pallida, and is characterized by lesions of the vessels and of the tissues surrounding them, excited by this parasite. Whether the lesions are excited by the parasite

[1] Clinical application of this test has, however, failed to prevent the appearance of chancre in three reported cases.

directly or through the medium of a toxin we do not know, though the latter is the more probable hypothesis. Nor is it yet clear whether the damage is done chiefly through the lymph vessels and spaces or through the blood capillaries.

With a few exceptions (of which the most notable are paresis, tabes, iritis, and the macular syphilid) the lesions of syphilis may be classed as perivascular, granulomata—i. e., infiltrations of the vessel walls and of the surrounding tissue with small, round cells and plasma cells. The vessels most commonly affected are the capillaries.

Syphilis is, therefore, classed (with tuberculosis and leprosy) among the infectious granulomata.

Lesions of the Capillaries.—The congestion and proliferation shows itself by dilatation of the vessel lumina, swelling and proliferation of the endothelium, and formation of new capillaries. Congestion and proliferation also occurs in the connective tissue surrounding the vessels, as a reaction to the exudation.

The exudation occurs in a "coat-sleeve" fashion, surrounding the inflamed vessels with a zone of infiltrate many times the diameter of the vessel itself. This zone gradually merges at its edge into the surrounding normal tissue. Groups of capillaries are usually affected and, when the inflammation is at all marked, the zones of infiltrate merge into one another to form an irregular area more or less widespread.

The exudate consists of small round cells and plasma cells, mingled with other cells (more or less proliferated) of the infiltrated tissue. Here and there a giant cell is sometimes seen. These giant cells are neither constant nor characteristic of syphilis (they are much more common in tuberculosis).

The reaction of the exudation upon the capillaries themselves is most important. The vessels are primarily—

1. Congested and proliferated, and secondarily—

2. Thrombosed, "their former site being marked by solid cords, groups of irregularly disposed cells with pale staining nuclei and giant cells with peripheral or central nuclei or both" (Fordyce [1]). Without discussing further the disputed origin of the giant cells, one may recognize that many of them are due to this capillary degeneration.

As a result of the thrombosis and destruction of the vessels, the infiltrated zones may be mottled, showing amid the cellular exudate lighter areas representing the degenerated capillaries. Moreover, when this vascular degeneration is extensive, there is macroscopic necrosis of tissue on the exposed surface or in the center of the lesion. Hence the erosion of chancre, the desquamation of the syphilitic papule, the ulceration of the tubercular syphilid, and the caseation of gumma.

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[1] *Jour. Am. Med. Ass'n*, 1907, vol. xlix, p. 462.

Three types of cellular exudate may be distinguished, viz.:

1. The diffuse exudate caused by an acute, intense syphilitic infection in a soil of little resisting power. This is seen characteristically in the visceral lesions of hereditary syphilis. A whole lobe of liver or lung is infiltrated; there is practically no tendency to localization of the exudate or to central degeneration (gumma); all the vessels are involved.

2. The circumscribed, mild, multilocular exudate with no tendency to central degeneration, but with a marked tendency to spontaneous resolution. Such are the ephemeral lesions of secondary acquired syphilis.

3. The circumscribed, grave, malignant lesions of tertiary syphilis (whose characteristics are shared in a less degree by the chancre), of which the gumma is the type. These tertiary or gummatous lesions thus consist in dense perivascular exudates with central degeneration (caseation) due to vascular obstruction and obliteration in the periphery of the lesion.

The Pathology of Gumma.—The *subcutaneous gumma* is a deep-set syphilitic tubercle. At its onset it is simply a syphiloma, a localized perivascular granuloma, set in the subcutaneous tissue. But its center soon breaks down into a gelatinous or gummy mass (whence the name "gumma"). This central gummy mass consists of necrotic tissue held together by a network of fibrous connective tissue, so that even when the mass is large and completely disorganized it does not become absolutely fluid, but is kept in a characteristic semisolid state.

This mass, yellow or sero-sanguinolent in aspect, rapidly enlarges and bursts through the skin. Through the ulcer thus formed the gummy center comes away bit by bit, leaving a gummatous ulcer.

Gumma of the internal organs (liver, testicle, etc.) behaves somewhat differently. It begins as a granuloma and undergoes central degeneration, but it finds no outlet, and is limited in its spread by the change that occurs in its own outer layers. Here the inflammatory exudate changes gradually into scar tissue, which completely envelops the central gummy mass. In this fully developed state the visceral gumma therefore consists of a central gummy mass, surrounded by a dense envelope of fibrous tissue, which itself is infiltrated and surrounded by plasma and small round cells. Healing takes place either by absorption or by encapsulation of the gummy mass. The contraction of the fibrous tissue leaves a characteristic hard, puckered scar.

The *diffuse gumma* forms still another pathologic type, in which the syphiloma is spread over a relatively large area, undergoes no central degeneration, and heals by complete transformation into scar tissue.

Lesions of the Larger Vessels.—Of the larger vessels the arteries are much the most commonly affected by syphilis, the veins less often, the lymphatics least of all.

The lesions are comparable to those that occur in the capillaries—i. e., exudation into and about the vessel with obliteration and degeneration as its terminal stage. Indeed, some larger vessels are often involved in the capillary lesions described above. But the typical syphilitic lesions of the large vessels, especially the arteries, derive their importance rather from the lesions of the vessels themselves than from those of the surrounding tissues.

The "coat-sleeve" infiltrate is seen about small vessels; but this systematic disposition of the exudate diminishes progressively in proportion to the size of the vessel attacked until, in the aorta, the lesions are usually patches distributed over the circumference of the artery, but showing no definite tendency to surround it.

The changes in the walls of the larger arteries are most common and have been best studied in the arteries of the brain. Whether these changes usually begin in the arterial intima, as Heubner, their discoverer, supposed, or in the adventitia, as is now generally believed, they spread around and along the vessel in the form of a round-cell exudate, usually involving the adventitia rather more than the intima, but in large measure sparing the muscular tissue of the media. Actual gummata may occur in the adventitia. Thus the wall of the vessel is thickened, its elasticity lessened, its intima congested and roughened. Hence in the smaller arteries the clinical result of syphilitic inflammation is usually thrombosis or obliteration, less often rupture or aneurysm, while in the aorta aneurysm is the clinical manifestation of the disease.

CHAPTER LXX

THE COURSE OF SYPHILIS

THE ONSET

Although utterly irregular in its course, syphilis is practically always quite characteristic in its beginnings (at least in the male), and thus the diagnosis of syphilis is happily most readily made at the time when it is most necessary to make it.

Onset in Man.—In order to get a picture of the way in which syphilis begins let us take, for example, a typical case in a man. He has intercourse on a given date (and may notice an abrasion upon the penis, or there may come out within the next few days a crop of herpetic vesicles. Yet in the great majority of instances neither of these things is noted). He thinks himself entirely normal and notices nothing wrong for a period of three to five weeks. Then he accidentally becomes aware that there is upon the glans penis or upon the foreskin a single pimple. This grows and becomes quite hard, and is eroded or ulcerated upon its surface. In a week or ten days the glands in one or both groins begin to swell, yet the sore itself and the glands are practically painless, and, as neither of them attains any great size, the patient may neglect to consult a physician. But, though relatively insignificant, the sore does not get well; the glands do not disappear. Three or four weeks go by and the ulceration upon the surface of the sore gradually heals, but a hard, typical lump remains under the epidermis. Then, in from two to three months from the time of infection, the first general symptoms appear.

First, he begins to feel a little miserable; his bones ache; he feels perhaps a little feverish, but probably not definitely sick, and may take no very great account of his malady until he notices a rash upon his body or some sore spots in the mouth or pharynx. These are pretty sure to bring him to the physician, who finds him with a characteristic macular, papular, or polymorphous eruption (to be described in detail later), with little sores in the mouth or pharynx, with disseminated, minute, scabbed ulcerations in the scalp, perhaps with a slight evening rise of temperature, and tender sternum and shins. He is in full secondary syphilis. The diagnosis is unmistakable.

Onset in Woman.—Such is the course followed by almost all men. In women the onset of the disease is by no means so characteristic. The chancre is so slight a lesion that it is usually overlooked by the patient, and she may fancy herself entirely well until, two or three months after infection, she begins to feel run down. She may have enough fever to fancy she has malaria, or she may be treated for an imaginary typhoid; or she may suffer from frightful pains in her bones, in her head, these pains coming on in the evening and much worse at night than during the day. A short while after the beginning of this outbreak of general toxemia she may show lesions of skin and mucous membrane quite as characteristic as those found in the male. But in a certain proportion of cases (9 per cent) these objective evidences are so faint as to be overlooked and, consequently, she does not present a typical and unmistakable picture of the disease. In such cases repeated miscarriages, or the birth of children that promptly die, may constitute the only early symptoms.

If the diagnosis is not made, her symptoms may gradually abate, and it may be years before a tertiary outbreak proves that she has syphilis. Or she may go on to have some characteristic lesion within a few weeks or months.

DURATION OF PRIMARY AND SECONDARY INCUBATION

Such is the beginning of syphilis as we see it clinically. It may be divided into two periods: the primary incubation, ending with the appearance of the primary lesion—the chancre—and the secondary incubation, ending with the appearance of the secondary lesions.

The extreme limits of the various incubation periods are:

First incubation (inoculation to chancre) = ten days to six weeks.

Second incubation (appearance of chancre to secondaries) = within five months.

Total incubation (inoculation to secondaries) = one month to six months.

But if the patient actually has syphilis, it is rarely necessary to wait so long, for clinically the secondary incubation falls within three months in 94 per cent, and the total incubation within four months in 96 per cent of all cases. What might be termed " the normal case " runs a primary incubation from two to five weeks, a secondary incubation from one to three months, a total incubation from six weeks to four months.

THE SECONDARY LESIONS

The secondary lesions, if anticipated by treatment, may never appear. Indeed, the early symptoms, both primary and secondary, are

entirely overlooked in 1 per cent of men (22 out of 2,170) and in 9 per cent of women (18 out of 207).

Definition.—The secondary lesions of syphilis are twofold: an acute toxemia and certain local lesions varying in character from simple congestion to exudation. These local lesions are not destructive in character, do not invade the adjoining tissues, do not undergo caseation, and on healing leave little or no scar. They have usually a spontaneous tendency to heal.

Secondary Toxemia.—Examination of the blood during the first few months of syphilis, or at least until the disease is controlled by treatment, reveals a chloroanemia. In the majority of cases in one's private practice this condition reveals itself but by one symptom: viz., loss of weight. One very frequently finds the syphilitic 10, 20, or even 30 pounds lighter at the end of six months than he was the day of his infection. This loss is gradually regained under treatment.

On the other hand, typical, severe, syphilitic toxemia with fever, prostration, and various pains, preceding the outbreak of the localized secondary symptoms, is so rare as to be almost always mistaken for malaria or typhoid fever until the eruptive lesions appear and establish the diagnosis, unless, as happened to a youth who came to me in the full glory of a general papular syphilid, it suggests measles.

The long-drawn-out debility, with loss of weight as its most striking symptom, is much more severe among women.

Local Lesions.—The first local secondary lesion appears on the skin in almost every case.

This first eruption is macular or maculopapular, and generally distributed over the trunk, less marked on the extremities. Exceptionally, it is preceded by a few scattered papules.

The Early Secondary Lesions.—But soon a whole group of lesions appears to form a characteristic picture of early syphilis. The body is covered with macules or papules; the scalp is full of moist crustaceous papules ("scabs," the patient calls them); there are pains in the joints, the bones, the muscles, the head; the mouth and throat are filled with mucous papules and erosions; the lymph nodes, especially the epitrochlear and posterior cervical, become enlarged, while the scar of the chancre with its satellite adenitis still marks the port of entry.

Such is the pathognomonic picture of secondary syphilis at its outset. The picture lasts, in any or all of its constituents, from a week or two to a month or two.

The Subsequent Secondary Lesions.—After the subsidence of this first outbreak the occurrence of secondary symptoms follows no rule. Lesions of the skin and mucous membranes are likely to relapse, but at what intervals one cannot prophesy. A surprisingly large proportion

of well-treated cases—perhaps one in five—have no further secondary symptoms. Relapses are most frequent in the first year.

Duration of Secondary Lesions.—While there is no absolute term to relapses of secondary lesions, no "secondary period" of syphilis, yet secondary lesions cease within the first four years in about 90 per cent of cases, within six or seven years in about 95 per cent. Secondary lesions appearing later than the tenth year are the rarest exceptions.

THE TERTIARY LESIONS

Definition.—Those lesions of syphilis which are localized and destructive of tissue are called tertiary. They consist of relatively diffuse infiltrations terminating in the production of masses of scar tissue or of relatively localized masses (gummata) tending to central caseation. The tertiary lesions show little tendency to heal spontaneously, but spread to the surrounding tissue, advancing in a circular or circinate way and destroying every tissue encountered in truly malignant fashion.

Occurrence.—The majority of cases of syphilis as we see it to-day do not have any tertiary lesions.

Tertiaries make their appearance more often in the second and third years of the disease than in any other two years; that even in the first year they are by no means uncommon (6 per cent, Fournier; 13 per cent, Keyes). In half the cases they appear first within three (Keyes) to seven (Fournier) years after the chancre. The beginning may be deferred for an almost indefinite time. Among my cases the four longest deferred began at thirty (twice), thirty-one, and forty years.

Relapses.—The intermittent or relapsing character of syphilis is most evident in its tertiary lesions. Relapses of secondary lesions usually occur at relatively short intervals of a few months; tertiary relapses at longer intervals.

About one third of my cases of tertiarism relapsed, and about half of these relapsing cases recurred no more after two years.

THE PARASYPHILIDS OR SYPHILITIC DYSTROPHIES

Definition.—The parasyphilids or syphilitic dystrophies are lesions or functional derangements for which pathology shows no syphilitic basis and for which the antisyphilitic specifics afford little or no relief. They are apparently toxic in origin, and may be caused by various forms of systemic intoxication. This systemic intoxication is usually, though not necessarily, syphilis—syphilis implanted upon a soil harrowed by an evil heredity or fertilized by debility due to such causes as malnutrition, excessive mental or physical strain or debauch.

Varieties.—Thus *the parasyphilids,* or syphilitic dystrophies, *include all conditions which, without being pathologically syphilitic, are clinically due to syphilis.* Their name is legion. A case showing "eczematous-looking" nails, apparently due to syphilis, and yet persisting after the truly syphilitic lesions had been cured, is an excellent example of a large and entirely indefinite class of conditions bearing no special hall-mark of syphilis, and yet arising during the active period of the disease. In the patient's mind such lesions are truly syphilitic: Thus one man tells me his skin "has never been the same"—another that the texture of his hair or nails has changed—since his syphilis. Another feels his spirit broken or his vitality gone; he never has regained the weight lost during the first months of the disease; he has been afflicted with neuralgic headaches ever since the disease began. Another has become hysterical or neurasthenic or syphilobic to an insane degree.

Are these functional or dystrophic conditions truly syphilitic in origin? Clinically, yes. Syphilis is undoubtedly the exciting cause. And yet in many such instances one feels assured that the constitution of the patient is much more at fault than the syphilis. The same rough skin or impaired vitality might have resulted from typhoid fever or from a severe mental shock or from prolonged malnutrition. The disorder is a functional disturbance of the nervous system evoked by syphilis, but whether evoked by terror or by toxin, it is often impossible to say.

1. Such is a large vague group which will or will not be classed as syphilitic dystrophies, according as the physician is materialist or idealist.

2. Again, there are a number of conditions manifestly not neurotic in origin, and of which syphilis, like any other chronic toxemia, may be the cause. Arteriosclerosis comes first to mind, and with it interstitial sclerosis of any viscus. Fournier would add certain cases of epilepsy, glycosuria, etc. Indeed, this class of cases is but little less broad and vague, but little more closely and essentially allied to syphilis than the preceding one.

3. In the third class, and strikingly emphasized by their frequency, their fatality, and their almost constant association with syphilis, are tabes dorsalis, paresis, and Erb's spastic spinal paralysis. These are the parasyphilids *par excellence.*

4. In a fourth class are the defects of development imparted by hereditary and, to a less degree, by infantile syphilis—the hereditary syphilitic dystrophies.

PROGNOSIS

The general prognosis of syphilis is a gloomy prospect compounded of various follies amid which madness for drink and carelessness in

treatment stand preëminent. Yet the cases which I have personally supervised from beginning to end have been singularly free from grave relapses, a freedom which I believe they owe to the system of treatment followed, and constant insistence upon the fact that relapses can neither be foreseen nor absolutely prevented by any system of treatment. If the patient is made to recognize that he cannot be guaranteed against relapse in his own person (however sure he may be that he is no longer infectious) he is—sanely—on his guard and prepared to report at the outbreak of symptoms when they may be promptly controlled.

In short, a case of syphilis intelligently treated and properly conducted usually terminates with the cessation of treatment at the end of three years in all things except the matrimonial guarantee, which is habitually to be reserved for two years longer.

The elements of the prognosis are:

1. The patient's constitution.
2. His environment.
3. His habits, chiefly as regards alcohol and tobacco.
4. His treatment.
5. The lapse of time.

The Patient's Constitution

In syphilis, as in any other disease, the most important element of prognosis is the way the patient *happens* to react to the infection.

But the effect of the constitution of the patient upon the course of the disease is by no means limited to the bald moderation or intensification of symptoms. Syphilis brings out every latent weakness. It encourages the development of tuberculosis. It plunges the hysterical and the neurasthene into new depths of despair. It feeds every organic neuropathic predisposition. On the other hand, the syphilis itself is colored by every tinge of heredity—diathesis and temperament alike. Persons of gouty tendency run to scaly and tuberculoid eruptions, and are said to be especially liable to syphilis of the nervous system (though I cannot substantiate this assertion). Eczema becomes almost inextricably intermingled with eczematoid syphilids (lichen planus, psoriasis, and similar skin lesions, though they may be closely simulated by syphilis, can scarcely be said to influence the course of the disease). The anemic or "scrofulous" victim suffers intensely from early toxemia, florid, general early skin lesions, and mucous-membrane lesions of a most persistent relapsing character. The neuropath is stricken in his point of least resistance. In short, syphilis assumes the habit of its victim. Its course depicts his weakness.

The Patient's Environment

Syphilis, like character, is founded upon heredity modified by environment. Every influence to which the patient is subjected may react upon his disease.

The Patient's Habits

Since the patient's native immunity to syphilis is his most important asset, to fortify that immunity should be his constant effort. During the first years of the disease he should keep "in training." Regular hours, simple food, plenty of sleep, fresh air, and exercise should be his rule of life in so far as his position permits. A regard for the elementary rules of hygiene is always helpful, and is in some cases of syphilis as important as in tuberculosis. Unfortunately, many syphilitics grossly neglect the rules of hygiene, and yet come to no immediate, manifest harm. Consequently, they treat lightly the warning that bids them look to a more or less distant and problematical future; they neglect to make every effort to stamp out the disease while it is yet young, and in later years they return groaning under afflictions that were quite preventable.

Alcohol.—The reaction of alcohol upon syphilis epitomizes the effects of bad environment and evil habits. Alcohol is the commonest as well as the most active enemy of the syphilitic. Malignant early syphilis is most frequent among those who have been alcoholic, malignant late syphilis among those who remain alcoholic.

In debating the effect of alcoholism in syphilis a strict definition of the term is essential. By alcoholism is meant chronic intoxication by alcohol. This does not imply drunkenness. A man may die of alcoholism without ever being drunk. Indeed, the man who boasts that he cannot get drunk has the opportunity of becoming far more alcoholic than he who is laid low by a stein of beer; and it is precisely among these hardy and incessant drinkers that the most pronounced evil effects may be looked for. Persistent drinking may make it impossible to prevent or to cure tertiary relapses.

But the essential evil of alcoholism is not that it so often makes the lesions of syphilis virulent and hard to cure, but that it, combined with inefficient treatment (and the two go hand in hand), is almost the whole cause of late syphilis. I have elsewhere cited my personal statistics in this regard, and my clinical impression is even stronger—much stronger—than my statistics.

Tobacco.—The ill effect of tobacco is immediate, local, and obvious. If it excites mouth lesions it must be stopped, but otherwise it may be used in moderation.

Time and Treatment

Time and treatment are the enemies of syphilis. Age certainly does wither her though time cannot be said to stale her infinite variety. If the disease relapses, appropriate treatment diminishes by fully 80 per cent the prospect of further relapse, though under this, as under any other geometric progression, an infinite number of relapses is possible.

Three out of 4 cases of syphilis, as we encounter it clinically, end within five years; 7 out of 8 within ten years; while only 1 in 30 lasts over twenty years.

Abstinence from alcohol and attention to treatment each cut down the average duration of the disease (as compared to alcoholic or ill-treated cases) by about five years.

MORTALITY FROM SYPHILIS

The most competent man to speak on this subject is the insurance examiner. Dr. Bross writes:

I think the conclusion is justified that syphilitics may be insured at any time after the symptoms have ceased to show themselves, but not at standard rates. Syphilis no doubt shortens the expectancy of life, and there is a largely increased mortality among the class during life.

This mortality is largely indirect, due chiefly to alcoholism, mental diseases, circulatory and renal diseases.

CHAPTER LXXI

DIAGNOSIS OF SYPHILIS

MEANS OF DIAGNOSIS

The means of diagnosing syphilis may be classified as follows:

1. Laboratory Diagnosis.—Examination for spirocheta.
   Inoculation of monkeys.
   Specific reaction.
   Examination of the blood.
   Examination of syphilitic tissue (biopsy).
2. Clinical Diagnosis.—History.
   Scars of previous lesions.
   Appearance of the present lesion.
   Effect of treatment.

Laboratory Diagnosis.—*Examination for Spirocheta.*—The opinion of a *real* expert is valuable confirmatory testimony. But even the most expert my fail to find the spirocheta when present, and may think he sees it when absent. Hence such evidence is only confirmatory. I find it most useful in the differential diagnosis of chancre and of buccal sores.

Inoculation of Monkeys.—This can never be generally employed for lack of subjects. It appears to be a reliable test.

Specific Reaction.—The only specific reaction at present available is the Wassermann test, the virtue of which has been already discussed (p. 736).

Examination of Syphilitic Tissue.—A snipping from the lesion may help differentiate gumma from neoplasm or tuberculosis. Yet in practice this is rarely employed, for the actual appearance of a specimen thus obtained is often quite nondescript. The pathologic characteristics of syphiloma are ill-defined and of a negative type, and it is often difficult to get a deep enough section of the growth to show its structure.

Clinical Diagnosis.—Whereas the application of the laboratory tests is as yet limited and bound to conform with the clinical findings, these latter are almost universally applicable. We are therefore much better

acquainted with the limitations of our clinical tests, and in the present state of our art they are the more reliable.

Yet there is a sharp distinction between the method of applying these two classes of tests. The laboratory tests are applied singly; the success of one of them is almost as convincing as though they all coincided. But the clinical tests must be applied all together. History and scars give us a hint of what *may be* the trouble; this impression is *strengthened or weakened* by the appearance of the lesion, and *confirmed or refuted* by the effect of treatment. When all four clinical tests agree we are certain beyond the certainty conferred by any laboratory report. But if they fail to agree we may remain in doubt, and the lesion may heal and leave us there. For recovery under antisyphilitic treatment is no proof that the lesion was syphilitic unless it was typically syphilitic in appearance or unless there remains a typical syphilitic scar.

Thus no one test is absolutely convincing. We must apply them all. In every instance we must endeavor to prove the patient syphilitic and the lesion and the effect of treatment must confirm our opinion.

The two following points in physical diagnosis may be mentioned:

Enlarged nodes are the exception rather than the rule in syphilis. Within two weeks after the appearance of chancre the typical inguinal adenitis appears, and lasts some three to six months. General syphilitic adenitis usually follows close upon the first general eruption, and disappears well within the year. Hence *syphilitic adenitis is extremely rare after the first year.*

Dr. N. B. Potter finds strong confirmatory evidence of syphilis in destruction of the large papillæ at the base of the tongue (Virchow's *atrophia levis*). These are palpable rather than visible. On passing the finger over the back of the tongue one feels it to be glazed and smooth instead of lumpy, as is the normal tongue. This destruction of the large papillæ by syphilis is common, though by no means constant. It may be of assistance in diagnosing syphilis, but is not an infallible sign.

DIAGNOSIS OF DIFFERENT PERIODS OF THE DISEASE

We may summarize here certain diagnostic situations that constantly come up.

The Initial Stage.—To diagnose syphilis by the appearance of a chancre one must find (p. 715)—

1. Typical chancre.
2. Typical regional adenitis.
3. Negative autoinoculation (p. 709).
4. Positive Wassermann, or discovery of Spirocheta pallida.

Unless the diagnosis is *absolutely* fortified by these precautions, one is not licensed to begin treatment before the secondary outbreak.

The Secondary Outbreak.—Various combinations of circumstances lead to a diagnosis at the time of the secondary outbreak. The most common combinations are the following:

1. General macular or papular eruption with the scar of chancre and persistent regional adenitis.
2. Scattered syphilitic papules with the chancre and lymphatic nodes.
3. Chancre and lymphatic nodes undiscoverable; general macular or papular eruption combined either with scabs in the scalp or mucous papules in the mouth, or symptoms of general toxemia (notably nocturnal pains).
4. Mouth lesions combined either with scabs in the scalp or characteristic general adenopathy.
5. Preëruptive fever with toxic symptoms, scar of chancre, and persistent nodes.

In a Period of Calm.—Within the first six months typical, posterior cervical, and epitrochlear adenopathy are usually found. If both sets of nodes are enlarged and the patient's history is suggestive of syphilis, it is proper to confirm the diagnosis, since the chances are that the patient has the disease, and it is, therefore, safer for him to continue treatment than to stop it.

After the first six months there is often no trace whatever of the disease. In this event we must depend entirely upon the history, and, even though it be not very impressive, it is usually wiser to continue the treatment on the diagnosis previously given; for there are no means of proving that the patient has not syphilis, and the omission of treatment may bring him grave relapses in the future.

Later Relapses.—The diagnosis rests chiefly upon the characteristics of the lesion and its reaction to appropriate treatment. But, as already stated, the patient's history should be searched and his body carefully inspected.

Tertiary lesions of brain, bone, and viscera quite often occur in patients who give no history of previous syphilis and show no scars. In such cases we must, therefore, go by the physical characteristics of the lesion. Yet the treatment instituted must always be regarded as tentative until the resolution of the lesion proves that it is syphilitic. The dangers of overtreatment, especially in obscure lesions of the nervous system which may or may not be syphilitic, must always be borne in mind.

Wassermann Test.—This is a great help as an adjunct in diagnosis at all stages of the disease.

CHAPTER LXXII

THE TREATMENT OF SYPHILIS

PREVENTION

Abortive Treatment.—To abort syphilis is impossible. Syphilis may abort itself; but even though no symptoms follow a true chancre we have no means of judging whether the disease is ended or whether we may look for an outbreak five or ten years hence. *Excision of the chancre does not abort syphilis,* clinically or experimentally, in man or in monkey. If the patient is seen within twelve hours of a suspected contact, mercurial ointment should be well rubbed into the suspected part. After twenty-four hours the ointment may be removed.

Beyond this nothing—neither cauterization, nor excision, nor internal medication—will abort syphilis.

GENERAL PRINCIPLES OF TREATMENT

In the treatment of syphilis the physician has two ends in view: viz., to prevent the appearance of symptoms and to cure them when they do appear—to control the disease and to cure its lesions.

These two ends are entirely distinct, and unless this distinction is kept constantly in mind a discussion of the treatment of syphilis becomes a mere muddle.

For example: It is routine practice to administer mercury without potassium iodid during the first year of syphilis. But if the patient develops a gumma during that first year, we promptly administer iodid, at the same time continuing the routine mercurial treatment. We are attacking the disease by mercury, the lesion by iodid.

Thus there are two treatments of syphilis, the one, routine to prevent relapse and control the disease; the other, symptomatic, to cure lesions.

THE ROUTINE TREATMENT

The routine treatment of syphilis is hygienic, tonic, and specific. The specifics are often ineffective unless aided by the others. No one of

them may be depended upon alone. They form component parts of one rational system.

No two authorities employ precisely the same routine treatment of syphilis.

In such a confusion it is impossible to do justice to every man's opinions. One can only describe one's own practice and the reason for it, leaving to objectors the privilege of following any other system that gives them better results.

Hygiene Is of the First Importance.—The brilliant effect of drugs often blinds us to the need of hygiene in syphilis. Yet hygiene is all-important.

The hygienic treatment of syphilis includes all the ordinary laws of health. Regularity of meals, of sleep, and of the bowels is necessary. No special diet is required. Air, exercise, and light, essential to all animal well-being, are particularly so in obstinate chronic disease.

In obstinate cases change of air is most useful. The nature of the change is not important: from seaboard to mountain, from inland to shore, sea trip or dry and high. Six weeks in any locality is long enough for the maximum beneficial effect.

I have more than once observed that a patient who could not take enough of this drug to control his symptoms in New York could readily do so out of the city. I have remarked the same fact in patients sent me from Chicago and elsewhere; they could with ease and advantage tolerate heavier medication in New York than at home. Many obstinate cases that fail to respond to treatment at home, especially if that home be in the city, make rapid strides toward recovery as soon as the air and surroundings are improved. Mercury and iodid do not cure all syphilis. The old chronic cases, relapsing endlessly in the dark and crowded tenements of our large cities and returning year after year to our clinics, often need hygiene far more than medicine.

The Hot Springs of Arkansas.[1]—This Mecca of syphilitics requires a word of serious comment. That it has positive value I am sure. But its positive value is reducible to precisely this: Under the stimulation of changed surroundings and aided by the hot baths, the old broken-down syphilitics, the alcoholics, those who have ruined their digestive functions by inundating themselves with iodid of potassium—in short, all those whose lesions fail to improve at home because they cannot tolerate the high doses of mercury and iodid required to cure them, can take such doses at the Springs.

But this is not to say that all syphilitics should go to Hot Springs; far from it. In the past five years I have sent only four patients there, and of those who have come to me from there, nine out of ten were no

[1] The following remarks apply equally to the syphilis cure at Aachen, Germany.

better off than they would have been from intelligent treatment at home; while some were greatly harmed, utterly dilapidated from overtreatment, and requiring months or years to recover from the effects of their experience.

Tonics Must not Be Forgotten.—If the patient is anemic, and this anemia does not improve under mercury, a little iron helps. The proprietary organic iron compounds are useful, but I often use the following:

℞ Sodii arsenat. ..... gr. ss to j (0.03 to 0.06 gm.);
Ferri reducti ..... 5j (4 gm.);
Pulv. rhei ..... 5j to jss (4 to 6 gm.).
M.—Fiant capsules No. xxx.
S.: One capsule t. i. d.

The mercury may be embodied in this capsule and strychnin may replace the arsenic. For neurotic patients hypophosphates and glycerophosphates also help; while, if they have lost much weight, cod-liver oil and other fatty emulsions are appropriate.

But it is in chronic cases that tonics are most serviceable. Here (p. 745) they form an established element of the treatment.

The so-called "specific" (nonmercurial) tonics have little tonic value. I think they owe their reputation to being employed when the patient has been drowned in mercury and iodid, and is ready to improve as soon as he recovers from the poisonous effects of these drugs. Under such circumstances any tonic (or no tonic) will work wonders, and whatever tonic happens to be used gets the credit.

Whether atoxyl [1] belongs among the specific tonics the future must decide.

Iodids Do not Prevent the Relapse of Syphilis.—Most of us have been educated in the "mercurialization" school. We do not remember how many treatments used to be devised in order to avoid giving mercury. We rarely see a patient who has dragged along under some "sarsaparilla" or "decoction," or perhaps under heroic doses of iodid in utter misery from which only mercury could save him. My father's greatest claim to scientific fame is the fact that before the International Medical Congress at Philadelphia in 1876, he struck the first blow for freedom from the error that mercury properly administered is a poison. Since that time iodid has played a less and less important part in the routine treatment of syphilis. But, though it is now generally recognized that iodin does not prevent relapses of syphilis, this drug retains its hold on the last years of the routine treatment of most physicians.

[1] Cf. Lesser, *Deutsche med. Wochenschr.*, July 4, 1907.

The precise reason for this practice I do not see; hence I do not accede to it. I employ iodin only for the cure of lesions, never in the routine treatment of syphilis.

Mercury Does Prevent the Relapses of Syphilis.—Mercury certainly does not cure syphilis. It hastens a cure by destroying the spirocheta, by curing certain lesions, and by minimizing relapses of the disease.

Mercury, Administered in Small Doses, is a Tonic.—I quote my father's words upon this subject:

> *It is not as a tonic, or because it is a tonic, that mercury cures syphilis* or alleviates it; but mercury may be so used in the treatment of syphilis that, over and above its specific influence, it may still not only do the patient no harm, but may be actually a tonic to him, doing him good—a point that no one has hinted at before, and many do not yet believe.

In the Routine Treatment of Syphilis Small "Tonic" Doses of Mercury are More Effective than Poisonous Doses.—This statement is obviously true, and is fortified by the experience of past centuries when mercury was administered in doses almost incredible to a less heroic age. Yet these furious assaults were utterly inefficient in controlling relapses.

So Long as a Sufficient Amount of Mercury Is Exhibited, it Matters not Whether it is Given by the Mouth, by the Skin, or by Injection.—The attitude of many syphilologists is this: We find injections (or inunctions) far more effective in curing symptoms than the administration of pills. Hence the same discrepancy must exist for the *prevention* of symptoms. The premise is not absolutely accurate, for certain symptoms are cured quite as quickly by internal medication as any other way, though in may instances injections and inunctions are certainly far more effective. But the reason for this effectiveness is that by these methods larger doses of mercury are promptly absorbed with less danger of poisoning than if the drug were given by mouth. But this quality of treatment, though excellent for the cure of symptoms, is unnecessary for their prevention, *so long as a sufficient amount of mercury can be absorbed by the stomach.*

The contention for injections and inunctions in the routine treatment is, therefore, valid only when the patient cannot, without poisoning, ingest enough of the drug to control the disease.

As a matter of clinical experience, so far as my records and my recollection go, there seems little to choose between the three methods of administering mercury for the *routine* treatment of syphilis, except in those patients who cannot digest enough mercury, or who cannot bear the pain of injections or the irritation of inunction.

THE TONIC TREATMENT

When the patient comes with his early lesions upon him he requires (*a*) that these lesions be controlled and (*b*) that their relapse be prevented.

First, he is given a preliminary instruction, covering the following points:

1. The gravity of his disease, the duration of treatment, the probability that his symptoms will be mild if he attends to treatment, the fact that he must continue treatment while well, just as though he were sick.

2. The great importance of hygiene, the necessity for abstinence from alcohol, and moderation in the use of tobacco.

3. How others are infected, and how to avoid this infection.

4. His need to have his teeth put in good order and kept so.

5. The necessity of reporting every little while that he may be weighed and his throat and urine examined.

The mercurial treatment is then instituted by an injection if the lesions are grave, but usually with G. and L. granules (p. 762).

Fifty of them are ordered, and (if it is a Monday morning) he is given this list:

Monday	..	1	1
Tuesday	1	2	1
Wednesday	2	1	2
Thursday	2	..	..

This means he is to take one granule after lunch and one after dinner on Monday; one after breakfast, two after lunch, and one after dinner on Tuesday, etc., and to report on Thursday.

If all goes well, his list is then continued to the following Monday, thus:

Thursday	..	2	2
Friday	2	3	2
Saturday	3	2	3
Sunday	3	3	3
Monday	4	..	..

with instructions that if he has two colicky, watery stools a day, he is to report immediately.

The dose is thus increased one granule a day until one of two things occurs: the colicky diarrhea or the subsidence of the lesions.

If the diarrhea comes first, the dose is dropped to half this maxi-

mum dose, and held there until the symptoms subside, when *the regular "tonic" dose*

2.....2.....2

is instituted. If the lesions disappear before diarrhea occurs, the "tonic" dose is instituted at once.

If the lesions refuse to subside within a few days, they are treated *secundum artem.*

After several months of treatment the digestion of the patient may begin to resent the mercury. Interrupt treatment a week or two and this will usually pass.

In the second year treatment is continued as in the first.

In the third year no treatment during the first six months. Resume routine treatment during the last six months.

In the fourth year no treatment if the patient has remained clean for two years; if not, three months (or more) of treatment.

In the fifth year as in the fourth.

In the sixth year matrimony permitted if the patient has been two years without lesions and without treatment.

This is the fundamental principle of the old "tonic" system, shorn of its "full dose," "reserve dose," and "tonic dose." We only retain the notion of a minimum dose. If the patient cannot take the dose stated above, his treatment is not adequate. No matter how clean his skin or how perfect his general health, he must take a certain minimum dose of mercury to minimize the danger of late relapses. This dose is arbitrary—theoretic, if you will [1]; yet without it there is no adequate prospect of cure.

If the patient cannot take the tonic dose of G. and L. granules, gray powder, bichlorid, or mercury and iron are tried. If these fail, turn to injections. If these are too painful, inunction.

Routine Treatment by Injections.—*Insoluble injections* may be given, one every two weeks, for a year, or until such time thereafter as there shall have been no symptoms for six months; then one every three weeks for the second year; then skip six months; then resume at one a month for six months. Relapse of symptoms should be the signal for resumption of injections every two weeks for three months after their cure.

[1] One instinctively looks upon the relapse of symptoms as the only index of inefficient treatment. Yet we daily meet vicious relapses in late years in patients whose lack of early symptoms led them to take no treatment at all. Without a theoretical minimum of mercury we have no standard to go by except the patient's general health. Under well-managed tonic treatment he should slowly gain weight until he regains or even exceeds his normal weight; his blood should become normal and, within six months or a year, he should be in the pink of condition. This tonic effect keeps pace with the antisyphilitic effect of mercury (though, as already observed, they are by no means identical) and is the best omen for the future.

Soluble injections are usually given as follows:

During the first three years courses of injections every other day, the first two lasting four to six weeks each, the last about four weeks.

During the second year, two courses of about four weeks each.

During the third and fourth year, one four weeks' course.

Routine Treatment by Inunction.—Interrupted courses, two or three weeks in length, of daily inunctions. Six to eight courses during the first year, four to six during the second, two to three during the third and fourth.

THE SYMPTOMATIC TREATMENT

The principles governing the symptomatic treatment are generally accepted and merely require brief enumeration.

Excepting the Early Painful Symptoms, the Secondary Lesions of Syphilis Call for Mercury.

The Early Painful Symptoms Call for Iodid.

Gummatous Lesions May Be Cured by Iodid Alone, but Are Better Managed by "Mixed" Treatment.

Sclerotic Tertiary Lesions and Lesions Difficult to Classify Require "Mixed" Treatment.—For such lesions, for instance, as tuberculo-ulcerative, serpiginous syphilids, both iodid and mercury are required. Some do better on high doses of the one, some on the other.

The Symptomatic Treatment Should Always be Vigorous.—The one thing probable (yet not quite certain) about relapses of syphilis is that they are caused by spirochetæ, which spirochetæ multiply in the active lesions of the disease. Hence, as an important adjunct to our routine treatment of syphilis, the symptomatic treatment should be vigorous in order to destroy as rapidly as possible these nests of infection. This is peculiarly true of the very lesions one is most apt to neglect.

This Vigorous Treatment Must be Continued Even after the Lesion has Apparently Healed.—Neumann very justly insists upon this point: viz., that the scars of apparently healed syphilitic lesions often contain areas of tissue which have the microscopic appearance of active syphilis.

Vigorous Treatment Is that Treatment which Effects Prompt Improvement.—We judge the treatment by its effects. If a gumma melts away under a few drops of iodid and a mild dose of mercury given internally, it is quite unnecessary to have recourse to harsher methods. Yet another case, apparently similar in every other respect, may not yield until 50 drops a day of potassium iodid are given; another may require 100, another 200, while still another may be obstinate until the mercurial effect is intensified by using inunctions or injections. Each lesion thus has its requirements, which can be learned only by experiment. One can never tell beforehand. An ancient destructive syphilid

often yields as rapidly to light doses as to heavy ones. The only rule to follow is this: Each lesion has its "dose," to which it yields promptly. Find this dose as rapidly as possible, and do not be misled by previous experience with other lesions into giving too small a dose to control the lesion or too large a dose for the needs of the case.

Severe Treatment Must Be Given in Short, Interrupted Courses, and Tonics Administered in the Intervals.—This is the underlying rule for treating grave destructive lesions of syphilis. Give mercury and iodid in increasing doses to the limit of toleration and then—*stop short!* Even though the patient seems no better, he should be given an intermission of *at least three weeks* to recover from the poisonous effects of these drugs. During this intermission iron, arsenic, and strychnin are administered, according to the needs of the case.

Local Treatment Avails Little.—Local treatment, whether by salves or powders or by electricity or X-rays or any of the newly discovered rays, avails little in syphilis. To this rule there are two notable exceptions. Secondary mucous papules and ulcers in and about the mucous membranes heal rapidly under light cauterization, and condylomata wither if kept dry.

CHAPTER LXX A

SALVARSAN

Such conclusions as have been thus far reached concerning the therapeutic application of salvarsan (or "606") are purely tentative. We know the composition of the drug, its physiological action, and its immediate effect upon the manifestations of syphilis. But its remote effects are entirely unknown to us; its toxicology is disputed; and no two authors agree as to the dose, the frequency of administration, and the interval that should elapse between doses. Under such circumstances it were impertinent to pretend to say the final word upon this subject, or even to attempt a full comparison of the effects of mercury and salvarsan. Therefore it seems prudent simply to sum up our present knowledge upon the subject in a special chapter without changing in any way the views expressed in other chapters of this work, written before salvarsan was discovered.

CHOICE OF METHODS OF ADMINISTRATION

Salvarsan should be administered intravenously. If a vein cannot be found large enough to be injected it may be necessary to give an intramuscular injection. For this purpose the alkaline solution of Alt and the neutral suspension should not be used. The former is excruciatingly painful and both are likely to cause extensive sloughing, and the deposit of arsenic from these injections is said to undergo degeneration into less complex organic compounds that are liable to cause atrophy of the optic or auditory nerve.

The best vehicle for intramuscular injections is hot iodipin.[1] The dose of 4 to 6 decigrams of salvarsan may be rubbed up in a mortar with 2 or 3 c.c. of this oil and injected through a large-caliber needle, either into the buttocks or into the erector spinæ muscle just above the level of the crest of the ilium. Intramuscular injections are more painful and less efficacious than intravenous injections.

[1] Albolin or liquid vaselin may be employed.

INTRAVENOUS INJECTION

Preparation.—The patient to whom salvarsan is to be administered should be examined for evidences of grave visceral or arterial disease. Advanced endocarditis, hepatitis, nephritis or arterio-sclerosis or tension constitute a contraindication to the use of the drug. But mild lesions, such as a compensated heart lesion, increase in arterial tension up to 200 millimeters, or slight albuminuria or cylindruria, may be disregarded.

Careful inquiry should be made as to whether the patient has taken any form of arsenic (notably atoxyl or enesol), as this may excite disastrous hypersusceptibility to salvarsan, the injection of which should be deferred until two months have elapsed.

The patient must take no hypnotics, sedatives or other drugs, except cathartics, within forty-eight hours preceding the injection.

The first injection should always be given at a hospital, in which the patient shall remain for at least eight hours thereafter and until his temperature falls below 100° F.

When repeated small injections are given the patient usually exhibits but a very slight reaction. Accordingly it is more convenient to give all injections after the first in the physician's office in the evening (the patient having taken a very light meal), after which the patient goes home to bed.

Apparatus.—The following apparatus is required:

A pint nasal douche bottle (as made by Whitehall, Tatum).

A glass-stoppered bottle graduated at every 50 c.c. up to 300 c.c.

A rubber tube a yard long, to fit over the outlet of the nasal douche bottle, interrupted near its farther extremity by a glass connecting tube and fitted with a hard-rubber connection to slip into the needle.

A Schreiber needle with a sharp point.

A rubber stopper for the neck of the douche bottle, perforated by a glass tube to which is attached the bulb of a Paquelin cautery.

A funnel and filter made of two layers of gauze with absorbent cotton between.

Sterile saline solution made from water *freshly distilled* and boiled.

Fifteen-per-cent sodium-hydrate solution.

Salvarsan.

Pipette, tourniquet (scalpel, forceps, etc., in case it is necessary to cut down on the vein).

All of this apparatus, together with a hypodermic syringe, cocaine solution, towels, rubber gloves, antiseptics, etc., are duly sterilized.

Technique.—The saline solution should be kept at a temperature of 110° F. Three hundred c.c. of this are poured into the glass-stoppered bottle, the salvarsan tube is opened and its contents dropped

upon the saline solution, which is then violently shaken until the salvarsan is completely dissolved. Sodium-hydrate solution is then added drop by drop until a heavy precipitate forms and is entirely redissolved. This requires from 16 to 25 drops. The bottle is then placed in a dish of hot water so as to prevent its cooling, the rubber tube is attached to the nozzle of the douche bottle, filled with saline solution by siphonage, and clamped with just enough saline solution inside the bottle to eliminate the possibility of air bubbles.

The alkaline salvarsan solution is poured upon this.

Meanwhile the bend of the patient's left elbow has been painted with tincture of iodine and the return venous circulation obstructed by a tourniquet placed around the arm just below the insertion of the deltoid.

The operator now takes the needle and prepares to puncture the vein. If the patient is oversensitive or the operator inexperienced 2 or 3 drops of cocaine solution injected beneath the skin will conduce to success. The inexperienced operator will also find that the easiest way to puncture the vein is by transfixing it with a round cambric needle, lifting this up, and inserting the salvarsan needle just below it. The more experienced operator will see that the vein is well distended, choose a sharp needle, steady the vein by drawing it firmly downward with the thumb of his left hand and insert the needle through the skin and into the distended vein.

If the needle is dull it pierces both walls of the vein at once and the resulting hematoma may force one to abandon this vein and inject another. Yet even if both walls have been pierced the lumen of the vein may still be found by withdrawing the needle until blood gushes from it, after which it is gently pushed upward within the vein beyond the puncture in the posterior wall.

When blood flows freely from the needle its point is surely in the vein. The tourniquet is immediately removed, the clamp taken from the rubber tubing, a few drops of salt solution permitted to gush from this to eliminate air bubbles and the tubing then connected with the needle.

If the needle is in good position inside the vein the injection may now be made by simply elevating the tank two feet or more above the level of the patient's arm. But if the flow is slow, it may be encouraged by gentle pressure with the cautery bulb attached to the stopper. Heavy pressure should not be used for fear of bursting the connections and so terminating the operation.

As the fluid flows the operator watches constantly for swelling about the vein due to infiltration of the subcutaneous tissue. If this occurs at all it is almost certain to happen while the salt solution is being injected and before the salvarsan reaches the needle.

Injection of salvarsan into the subcutaneous tissue excites great pain, inflammatory reaction, and even sloughing. If the patient complains of considerable pain up the arm during the operation, it is best to bring this to a close, since such pain is evidence of irritation within the vein which will result in phlebitis; but pain at the point of injection may be disregarded unless it is unbearable.

At the close of the injection it is customary to inject a few c.c. of salt solution, but there seems no need of this and I have rarely practiced it.

If the preliminary filling of the tube with saline solution seems inconvenient, a piston syringe may be substituted for this or one may use the rather clumsy three-way stopcock, described in most works upon this subject. For the administration of small doses of salvarsan I have employed a 20 c.c. syringe, a three-way stopcock and an ordinary hypodermic needle.

Of late I have omitted the alkalinization of salvarsan. This simplifies the technique by eliminating the sodium-hydrate solution and the need of filtering, for the acid solution is always clear if made from distilled water, while the addition of alkali often leaves an insoluble flaky cloud suspended in the solution. *Injection of concentrated acid solution is extremely dangerous,* since it is alkalinized by the blood, produces a thick clot, which may form in the heart and kill the patient instantly. But if the solution is given at the usual dilution—50 c.c. to each decigram of salvarsan—no clot is formed and the reaction after the injection is no different from that after injection of the alkaline solution.

The expert operator may further simplify the injection by eliminating the preliminary injection of salt solution, and using distilled water without salt as a vehicle for the salvarsan.

Dose.— For adults the full dose is 4 to 5 decigrams repeated every two or three weeks until two or three doses have been given. But inasmuch as it is impossible to state that these large doses will not cause a violent reaction, and inasmuch as small doses frequently repeated apparently give fully as good results without any untoward reaction, the recent tendency is to give doses of 2 to 3 decigrams and to repeat them every week or two, for five or six doses.

For children from five to ten years of age, 1 decigram may be given at a dose and repeated after a two-weeks' interval.

For infants, 0.01 to 0.02 grams (0.1 to 0.2 decigrams) has been administered in oily suspension into the muscles of the buttock. Intravenous injection is impossible on account of the minute caliber of the veins. The alleged beneficial effect upon the nursing infant of salvarsan administered to the mother is inconstant and not to be depended upon. Indeed, salvarsan therapy of the syphilitic infant has not yet been satisfactorily worked out.

After-Effects.—If salvarsan has been injected into the subcutaneous tissue a wet dressing of boracic-acid solution should be applied for twenty-four hours, followed by a ten-per-cent ichthyol ointment until the induration subsides. Apart from this the patient may expect no discomfort until from one to twenty-four hours (usually three or four hours) after the injection; the temperature suddenly rises, remains up usually for three or four hours (sometimes much longer), and then falls. The rise of temperature may be accompanied by chills, nausea, vomiting, and diarrhea. Its fall is the signal for permitting the patient to leave the hospital. But if *freshly distilled* water is used, the solution made up at the bedside, and injected hot, one need expect no important reaction unless more than 3 decigrams of salvarsan are injected.

Local after-effects of the injection are usually *nil.* Exceptionally an induration persists at the point of puncture, or a phlebitis, characterized by thickening of the vein without complete obstruction of its lumen, which prohibits further injections into this vein.

During the two weeks following the injection, the patient should avoid alcohol and drugs and all manner of strain to mind or body and live a regular and simple life. During this period he may suffer from slight catarrh of the air or alimentary passages, or a transient albuminuria. But if care is exercised in the preparation and injection of the drug none of the graver untoward effects, such as resulted from the methods formerly employed, need be looked for.

TOXICOLOGY

Grave poisoning from salvarsan is immediate or late. Immediate poisoning comes on within twenty-four hours and is characterized by a sudden irregularity and failure of the heart action, which may or may not be accompanied by localized or general paralysis. The patient may die in spite of vigorous stimulation.

The other type of grave poisoning comes on at least several weeks, and often several months, after injection. It shows itself by paralysis of single nerves or groups of nerves. The auditory nerve is most commonly affected; the optic nerve stands second. The paralysis may be unilateral or bilateral.

These lesions occur a long time after the injection, and almost exclusively in patients with early syphilis, and a certain proportion of them get well under mercurial injection, or even under repetition of salvarsan. Hence it has been assumed that the lesion is actually a syphilitic one to which these nerves are especially prone after salvarsan injection, either because the arsenic impairs the nerve itself, or because spirochetæ already active about the nerve at the time of the

first salvarsan injection are not slain by this injection, on account of the poor circulation in the bony canal through which the nerve runs as it issues from the cranium. Yet, since the salvarsan destroys the majority of the spirochetæ in the patient's body, these survivors attack the nerves more vigorously (than in cases of syphilis untreated by salvarsan) because the patient's resistance to the disease is diminished or entirely done away with by the destruction of the most of the spirochetæ in his body.

Neither of these theories has much evidence to support it, and inasmuch as the majority of paralyses have occurred after intramuscular injection of salvarsan, some authors hold that they are the result of arsenic poisoning from the slow and imperfect absorption of salvarsan when given into the muscle.

Whatever be the true theory, the fact is that sudden death and remote but perhaps permanent blindness or deafness may result from the injection of salvarsan.

Yet skillful operators do not seem to get such results. Among my patients I have seen one case of optic atrophy, following one intramuscular injection given by me and two intravenous injections given by another physician. From intravenous injection I have never seen the slightest ill effect, and with care in preparation and administration of the drug and the employment of repeated small doses it seems almost certain that in the future we shall hear no more of these horrors, unless the drug is employed upon patients in grave danger of death from arterial sclerosis (especially with high tension) or with marked visceral degeneration.

THERAPEUTIC APPLICATION

Salvarsan is reputed to cure various protozoal diseases, such as sleeping sickness, malaria, yaws, and syphilis. Our interest in it is confined to the last-named disease.

When first introduced, the drug was expected to cure syphilis rapidly and permanently by one injection. Ehrlich had found that certain other arsenical preparations, if given in sufficient quantity to mice infected by trepanosomes, cured them by a single injection, whereas if the drug was injected in a quantity sufficient to inhibit but not to cure the infected animals, repeated injections had less and less effect, and finally the trepanosomes resisted the action of what, in the first place, would have been a curative dose. Consequently, it was assumed that the Spirocheta pallida would act in the same way, and efforts were made to give the largest possible dose (0.6 gm.) in the hope of killing all spirochetæ, lest those that survived should develop immunity to the action of the drug. But experience soon showed that even the largest doses of salvarsan only temporarily checked the activity

of the disease. On account of the danger of frequently repeating the maximum dose, and also on account of the discomforts, danger, and relative inefficiency of intramuscular injection, it has become the custom to use only intravenous injections, and these in relatively small doses and frequently repeated.

Thus salvarsan begins to assume its rational place in the therapy of syphilis, in doses of 2 to 3 decigrams, administered intravenously, not oftener than once a week or less often than every two weeks and repeated four to six times.

At the end of such a course the lesions should be cured and then the question arises whether the treatment shall be continued by further courses of salvarsan injections or by single injections at longer intervals or by the familiar mercurial treatment.

Salvarsan has been employed for so short a time that we have as yet no sufficient clinical information to answer this question. Until it is answered the prudent practitioner will only use salvarsan to cure the lesions of syphilis, or at most to control the disease in its incipiency. Thereafter it is wise to resume mercurial treatment as though no salvarsan had been given.

COMPARISON OF SALVARSAN WITH MERCURY AND IODIDS

The following general rules may be laid down:

1. The early lesions of syphilis, especially the chancre and the mucous patch, are much more rapidly controlled by salvarsan than by mercury, and at this stage salvarsan often shows a marked tonic effect to prevent the pain, loss of weight, and the depression of spirits, so common in early syphilis.

It is, therefore, advisable to give a course of salvarsan injections to every patient seen at the onset of his disease.

2. Late secondary lesions and tertiary lesions are sometimes better controlled by salvarsan, sometimes better by mercury and iodids. The treatment of such lesions is, in the present state of our knowledge, a matter of choice.

3. The squamous lesions of palms, soles, and tongue are, however, usually much more amenable to salvarsan than to mercury; for them salvarsan is the treatment of choice.

4. As a general rule, visceral syphilis yields more rapidly to salvarsan than to mercury. Yet the patient, especially an alcoholic patient with grave visceral lesions, should be given salvarsan only in very small doses (1 to 2 decigrams) and under rigorous observation, since he is peculiarly susceptible to acute poisoning by the drug.

5. Lesions of the nervous system when acute yield more rapidly to

salvarsan than to mercury, but when chronic probably do as well under mixed treatment.

6. Tabes and paresis are as little affected by salvarsan as by mixed treatment; at the onset either may do good; later no benefit is to be expected.

7. The effect of salvarsan upon the Wassermann reaction has not been sufficiently studied. Large doses usually change a positive into a negative reaction. But after a single dose the reaction begins to become positive again after an interval of six to twelve weeks in most cases. Better results are obtained by the repeated injection of small doses. But there is not yet sufficient information at hand to prove whether or not salvarsan is more efficient in this regard than mercury.

CHAPTER LXXIII

MERCURY

TOXICOLOGY

Salivation.—Salivation is the commonest form of mercurial poisoning. It may occur from the use of mercury under any form.

Symptoms of Mild Salivation.—The first symptom noted by the patient is a *coppery taste* in the mouth. This is accompanied by a very heavy *disagreeable odor* to the breath; the *tongue and cheeks become edematous* and show the marks of the teeth; the *gums bleed;* the *teeth feel sore* and elongated.

Examination of the gums reveals localized areas of congestion, *especially about the lower incisors* or about any decayed tooth. When the lesions are more pronounced the gums actually ulcerate. The *pathognomonic mercurial ulceration appears behind the lower incisors and back of the lower wisdom teeth.* Ulcerations may occur elsewhere in the mouth, and it may be almost impossible to distinguish the lesions due to the medicine from those caused by the disease.

Actual *salivation* is usually slight at first, though in some cases the excessive flow of saliva is the earliest symptom.

Symptoms of Severe Salivation.—Nowadays one does not often see "good, old-fashioned" salivation, the patient depressed, feverish, stupid, his tongue swollen beyond recognition and gangrenous in spots, a constant stream of ropy saliva drooling from his swollen lips, his teeth loosened and falling, even his jaws becoming necrotic, and his breath permeating the atmosphere with an intensely disgusting fetid odor.

Treatment of Salivation.—So important is the care of the mouth in the *prophylaxis of salivation* that the patient about to take a course of mercury should be carefully instructed how to keep his mouth in good condition.

He must first have his teeth filled and thoroughly cleaned by a dentist.

He must brush his teeth morning and night.

He must rinse his mouth morning and night with chlorate of potash, gr. xv (three 5-grain tablets), dissolved in half a glass of water or with an alkaline mouth wash.

He must smoke little.[1]

He must report the instant his gums become swollen or sore.

The *treatment of mild salivation* consists in painting the gums with one of the following solutions:

℞ Tr. myrrh.,
Tr. iodi comp., } .....āā 3j (4 gm.).
Aquæ,

S.—Apply to gums once or twice a day.

Or

℞ Acid lactic ..... 3j (4 gm.);
Aquæ ..... 3ij (8 gm.).

S.—Apply to gums once a day (Tennesson).

Or

℞ Acid chromic ..... gr. xv (1 gm.);
Aquæ ..... 3v (20 gm.).

S.—Apply to gums every other day (Berdal).

The ulcerations may be touched once a week with liq. hydrarg. nitratis (50 per cent), or with the solid stick of nitrate of silver. Meanwhile, let the patient suck during the day two or three tablets (āā gr. v) of chlorate of potash.

The bowels must be kept open (they are usually loose, anyway) and the *mercury stopped.*

For severe cases free purging and diuresis, hot baths, a milk diet, and *suspension of the mercury* constitute the most important treatment. The local applications may be used as in mild cases, but cauterization had better be omitted. Ulceration of the cheeks may be lessened by separating them from the teeth with pledgets of cotton dipped in boric-acid solution or with a piece of raw turnip.

Entero-colitis.—A sharp diarrhea with colic usually accompanies severe salivation.

To prevent this is the art of managing the internal treatment.

To cure it stop the mercury, put the patient on a fluid diet without milk, and, after giving a sharp purge, administer bismuth (gr. x), beta-naphthol bismuth (gr. x), castor oil (♏ x), and salol (gr. v), or opium.

Mild cases are promptly relieved by stopping the mercury.

Nephritis.—The normal kidney secretes mercury in small doses perfectly kindly. But mercury may produce congestion of the kidney or nephritis either—

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[1] I am not sure that the irritation of tobacco is an important contributory cause of salivation, but I know it predisposes the patient to syphilitic mouth lesions.

1. When the kidneys are diseased, or
2. When mercury is given in poisonous dose.

Any form of acute or chronic nephritis makes the kidneys a poor filter for mercury, and since mercurial nephritis is the rarest form of mercurial poisoning, there is always room for suspicion that the kidney is chiefly at fault. This is further emphasized by the fact that there occurs an acute secondary syphilitic nephritis which may be mistaken for mercurial nephritis.

The chief practical point in regard to nephritis is that *the urine should be examined when mercurial treatment is instituted, and should be repeatedly examined during any severe course of mercury.*

Albuminuria or nephritis does not contra-indicate the administration of mercury, but does give warning that it must be given in small doses and with constant attention to the condition of the renal function.

Dermatitis.—Some skins are very sensitive to inunction, and in general the hairy portions of the skin become irritated most readily.

Mercurial dermatitis begins as an erythema which, in severe cases, goes on to an acute eczematous condition (mercurial eczema).

There is also an extremely rare dermatitis, due to a peculiar individual susceptibility to the internal administration of mercury. The eruption is scattered, erythematous, urticarial, or eczematous. It burns or itches; in fact, is a typical toxic eruption. Though said to be commonest after internal administration, the only case I have seen was a sharp urticaria following injection.

The *treatment* consists in stopping the mercury (for a time, and then using it in small doses), soothing lotions, and catharsis.

Ill-effects of Prolonged Mercurialization.—Mercury can be given quite indefinitely in nontoxic doses. But prolonged courses, even if only moderately severe, produce emaciation, anemia, and general vital deterioration, such as would ensue upon any chronic poisoning.

If the medication has been much prolonged, or extremely severe, the patient may be left with chronic nephritis or gastro-enteritis, from which he will never recover.

ADMINISTRATION

Mercury is administered in syphilis internally, by inunction, by intramuscular or subcutaneous or intravenous injection, and by fumigation. It may also be applied locally, but is rarely so used. Mercurial baths and mercurial shirts or sacks are no longer generally employed.

Internal Administration

Drugs Used.—The preparations commonly employed are protiodid, gray powder, bichlorid, and blue pill.

Protiodid (*Hydrarg. Iodid. Flav.*).—If the patient can take them I usually employ for the routine treatment Garnier and Lamoureux's granules of (green) protiodid; not because they contain iodin, for this is not present in therapeutic quantity; nor because they agree with the patient, for they are not peculiarly easy to digest. But their double virtue consists in this: they control the symptoms of syphilis very efficiently, and in case of poisoning they strike the bowel rather than the mouth—they purge before they salivate. Hence they possess the great practical virtue of being the safest form in which to confide mercury to the patient's own hands.

The granules contain a centigram each of protiodid. The minimum tonic dose is six granules a day.

Other iodids of mercury I rarely employ for internal treatment. The biniodid is too poisonous. Yellow protiodid tablets, the favorite American remedy, in the routine treatment of syphilis are so irritating to the bowel that only the most hidebound constipation resists the explosive effects of the minimum tonic dose; viz., one grain a day.[1]

Gray Powder (*Pulv. Hydrarg. Cum Creta*).—This is an excellent preparation, preferred in England to all others. Six grains a day is the tonic dose. It may be administered in one- or two-grain tablets. Some patients take this far better that the protiodid (G. and L.). Indeed, I have often given as much as fifteen grains of gray powder a day in attempting to control symptoms.

Bichlorid (*Hydrarg. Chlorid. Corrosiv.*).—If given alone, this preparation must be put in pill or capsule, for in tablet form it is likely to irritate the throat and esophagus. It is not much employed in early syphilis, but in the later stages of the disease is the favorite mercurial ingredient of "mixed" treatment. The minimum tonic dose is one sixteenth grain.

Blue Pill (*Pil. Massæ Hydrarg.*).—This is another preparation of mercury popular in the late rather than in the early days of the disease. The minimum tonic dose is three grains a day. But twice or three times that amount may often be given. A patient using this preparation should be under constant observation, as it strikes the gums more suddenly and severely than any other form of internal treatment.

Calomel (*Hydrarg. Chlorid. Mitis*).—This is no longer used in the internal treatment of syphilis.

Tannate of Mercury.—This is favored by certain practitioners. The tonic dose is three to six grains a day. I have not been able to dis-

[1] It is a great pity that in therapeutic efficiency no other manufacturer has been able to equal the G. and L. granules. They are chemically impure; that is manifest, yet they work better than the purest yellow protiodid.

cern its peculiar virtues. It appears to vary in strength in different preparations.

Many *other preparations* are fancied by certain individuals, but their vogue is slight, their merits ill-defined. It is proper, however, to mention two old and familiar mixtures containing mercury. The one is a *pill of mercury and iron:*

℞ Massæ hydrargyri,
Ferri reducti,
Gum tragacanth, } ..... āā 3j (4 gm.);
Glycerin ..... q. s.

M.—Fiant pil. No. lx.
S.—One pill after each meal.

The other is often called *Sir Astley Cooper's tonic:*

℞ Hydrarg. chlorid. corrosiv. ..... gr. i–ij (0.06 gm.);
Tr. cinchonæ co. ..... ʒiv (100 c.c.).
M.
S.—Teaspoonful in water after meals.

Rules for Treatment.—Besides the care of the mouth and the occasional urinalysis, the following precautions are necessary:

Do not Give Opium with Mercury.—The callousness with which Continental authorities prescribe opium in the treatment of syphilis is quite inexplicable. Syphilis confers no immunity to this drug. The opium habit is as readily formed by a syphilitic as by any other.

Do not Begin with a Full Dose.—In order to permit the patient to take a full dose comfortably, it is safe practice to begin with half the dose and work up gradually; thus for protiodid, begin with three granules a day, and increase one daily until six are being taken; for gray powder, begin at three grains a day, and increase a grain a day; for blue pill, begin at one and a half grains a day.

To Spare the Patient's Digestive Organs an Intermission of a Few Days may be Occasionally Necessary.—The advent of summer and fresh fruit introduces in many patients an inability to take the full dose of mercury. Regulation of diet may help overcome this; but it is often necessary to intermit treatment a week or so. Such intermissions, even though occurring as often as six times a year, do not invalidate routine treatment.

Merits of Internal Treatment.—Continuous internal treatment has the merit of being easy to remember and little trouble to follow. But it may be impossible for the patient to digest mercury in sufficient quantity for the control of symptoms or for their cure. It is the least effi-

cient way to administer the drug; yet it is often quite efficient enough. If, in the routine treatment, it can be taken in the necessary minimum dose, and so prevents relapses, or, if in the symptomatic treatment it causes the lesions to heal promptly, there is no need to employ other and less convenient methods.

Yet, in employing internal medication, we must guard against the patient's carelessness. We must not permit him to neglect even mild symptoms or to become indifferent as to the regularity of his treatment. He must be seen, examined, and encouraged at least every three months.

Intramuscular Injections

Preparations Used.—The preparations of mercury employed for injections are either soluble or insoluble. The chief *soluble preparations* are the bichlorid and the biniodid.

The chief *insoluble preparations* are the salicylate, gray oil, and calomel.

Bichlorid.—This salt is used in 1-per-cent or 2-per-cent solution with salt solution, various quantities of salt being used by different authorities. The following is an excellent combination:

℞ Hdyrarg. chlorid. corrosiv. .... gr. xv–xxx (1–2 gm.);
Sodii chlorid. ..... gr. x (0.6 gm.);
Aquæ destillat. ..... ʒiij (100 c.c.).
Dose: 1 c.c. (♏ xv).

Biniodid.—The red iodid of mercury is employed either in oily solution or in so-called "serum" or mixed with potassium iodid. It appears under various proprietary names. I have employed cypridol, the Hannam's and Lafay's sera. These preparations are popular on the Continent, but are little used here. I prefer the following:

℞ Hydrarg. biniodid. ..... ℈ss (2 gm.);
Potass. iodid. ..... gr. xv (1 gm.);
Aquæ destillat. .....ad ʒiij (100 c.c.).

Among the soluble preparations the succinamidate (1 cgm. dose) and the soziodolate are well spoken of, though the latter is apparently soon reduced to biniodid.

Salicylate. — This may be put up in 5-per-cent or 10-per-cent strength. The mixture I employ is:

℞ Hydrarg. salicylate ..... gr. xlviii (3 gm.);
Albolin (sterilized) ..... ʒj (30 gm.).
Shake.—Dose: ♏ x (0.7 c.c.).

The salicylate settles to the bottom and has to be distributed by vigorous shaking. The admixture of a little lanolin makes a better suspension but a thicker mixture.

Gray Oil.—Gray oil is an emulsion of metallic mercury.

The formula I employ is that of Lafay:

℞ Hydrarg. bidestillat.[1] ..... 5ijss (10 gm.);
Albolin ..... 5iij (13.5 gm.);
Lanolin ..... 5jss (46.5 gm.).
Shake.—Dose: ♏ ij–vj (0.1 to 0.4 c.c.).

Calomel.—Calomel oil is made by pulverizing the drug, washing in boiling alcohol, drying in an oven, and then thoroughly mixing with ten parts of sterilized albolin. Dose: 0.5 c.c.

Method of Administration.—*The soluble salts may be given subcutaneously,* but this method is unnecessarily painful. They are best given—and *the insoluble preparation must be given—into the substance of some thick muscle.* Injection of an insoluble preparation subcutaneously invites abscess or gangrene.

The *site* usually selected for injection is the buttock. The pectoral muscles or the thick muscles of the interscapular region or loin may also be utilized. Successive injections are given on alternating sides, and no two injections should be put within an inch of each other on the same side.

The best points for injection are:

1. A point midway between the ischial tuberosity and the upper edge of the trochanter on a horizontal line at a level with the latter.

2. A point directly above this and midway to a line joining the anterior superior spines.

3. A point on the same (horizontal) level as No. 2 and halfway between the trochanter and the intergluteal fold.

The implements are a sterilizable, hypodermic syringe (preferably all glass, as metal instruments are amalgamated by mercury), and a needle two inches long and of ample caliber; for very stout persons the needle should be two and a half inches long.

Technic.—Boil the implements, wash your hands, and, making the patient lie upon his face, rub the buttock well with alcohol.

Then, having filled the syringe and attached the needle, plunge this up to the hilt in the appointed spot and inject. Then withdraw the needle and pinch up the subcutaneous fat so as to obliterate its track.

Bleeding is readily controlled by pressure and adhesive plaster.

Dosage.—It will be found that any of these preparations may be given to certain patients in very high doses.

[1] This is the "dentists' mercury."

But equally good results, nay, better ones, may be obtained by the ordinary doses given above, and *an apparent toleration on the part of the patient should never tempt us to excessive hypodermic medication.* I know no rule more important than this, for excessive medication by injection produces a distinctly cumulative effect. The mercury continues to be absorbed for many days after its injection, and I have twice (once in my own practice) seen *severe and prolonged salivation begin in the second or third week following cessation of treatment by insoluble injections,* and continue for many weeks thereafter.

The injection method is a wonderfully effective, but a dangerous, weapon. It should never be employed carelessly or in excessive doses. *If the lesion does not yield to the usual doses, the way to a cure is not* through an increase in dose or prolongation of treatment, but *by stopping the mercury and giving a course of iodids or tonics.*

The choice between soluble and insoluble injections is largely a matter of taste. Both have their champions for the routine as well as for the symptomatic treatment of syphilis. But since the insoluble preparations have been perfected, and since the necessity for actually injecting them into the muscle has been generally understood, the vogue of soluble injections has diminished. *None of these injections is absolutely painless* (despite what their votaries say to the contrary), and, since soluble injections have to be given every day for a "course" of ten to thirty injections, the pain caused by them is cumulative, and in the end may be less tolerable than the more severe [1] but less often repeated pain from insoluble injections.

A more important distinction is this: *Insoluble injections are the more efficient,* and, since efficiency is the one claim made in favor of injections, this fact is gradually forcing insoluble injections to the fore.

On the other hand, *the action of insoluble injections is relatively slow to begin and long continued.* For this reason, as already stated, it is sometimes wise to begin with a few soluble injections to hurry on the effect of the drug while relying in the main upon the more efficient insoluble injections.

On the other hand, we have to consider the relatively grave accidents that may result from insoluble injections.

Disadvantages of Injections.—*Soluble.*—The disadvantages of *soluble injections* are the cumulative pain, the relative inefficiency, and the necessity for daily visits to the physician.

Insoluble.—The disadvantages of *insoluble injections* are general and local.

The *general disadvantages of insoluble injections* are poisoning and embolism.

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[1] Not always, but usually.

Acute mercurial poisoning may follow within twenty-four hours of a single injection of mercury. It is characterized by cramps, explosive diarrhea, depression of spirits, even fever; it may last several days. If the usual doses are employed such an attack follows the first injection once in every thirty or forty cases. It is not prohibitive. Lessen the dose at the next injection, and thereafter return to the full dose.

Grave salivation follows any overdosage with mercury, but that following injections of insoluble mercury has two very annoying characteristics: It is slow to appear and slow to disappear.

Embolism is due to a drop of the oily injection whisking off into the general circulation. It is caused by the perforation of a vein, and is to be guarded against, as far as possible, by the maneuver already related. The embolism is almost always pulmonary; its symptoms may appear the day after injection, though they usually follow it immediately.

After a more or less marked premonitory stage of slight fever and malaise, the attack begins with a sharp pain in the side, which interferes greatly with respiration. The temperature and pulse rise; the patient is much prostrated. The physical signs are those of a circumscribed pneumonia. The whole attack lasts from a few hours to a week. Curiously enough, the injection which causes the embolism is often remarkably painless.

The frequency of embolism is estimated at about one in a thousand injections. I have had but two in my practice and my father one; this in several thousand injections. One or two fatal cases of mercurial embolism have been reported.

The *local disadvantages of insoluble injections* are pain, induration, abscess, sloughing.

The *pain* varies greatly. Soluble injections are painful for one to three days; during this time they may cause agony. Insoluble injections give no immediate pain unless a nerve is actually punctured by the needle; but in from six to twenty-four hours the spot begins to ache, and this ache increases for a day or two longer, then gradually diminishes, but may last ten days or more.

The first injection is likely to hurt more than subsequent ones, but no two of them are alike. One may set up an intense sciatica, lasting a week, and the next one be almost painless. Some persons feel the pain much more than others. Indeed, it is practically prohibitive in certain cases. Yet I shall always remember one of my first experiences with mercurial injections. The patient was a neurotic woman; she was losing the ala of her nose; she had tried every treatment except injections—inunctions, fumigations, high doses of iodid, all in vain. Small wonder that she accepted injections at any cost. Yet every one I gave her made her vomit for hours and kept her in bed a day. But six injections cured her. It was worth the price.

On the other hand, I have a number of patients who prefer injections to internal medication even for routine treatment, and, curiously enough, one of my most neurotic patients has been on injections of salicylate for the past year, and asserts that they cause no pain whatever.

Indurations may occur even from insoluble injections. I have had a patient come to me with both buttocks a solid indurated mass from injections of bichlorid. As a rule, however, even insoluble injections should leave no induration. But if the injection is not made deep enough, or if any of the injected fluid leaks back along the track of puncture a red, tender, edematous swelling in the subcutaneous tissue results. After several weeks this subsides, leaving an induration, somewhat sensitive to pressure, and over which the skin may remain for a long time bluish and glossy.

Such reactions are rare. They are apparently unavoidable in certain fat, soft subjects, but they can almost always be prevented by proper technic.

Abscess and gangrene are usually due to dirt or carelessness. Neither accident has occurred in my practice.

Inunction

Preparations Employed.—The *officinal blue ointment* (ung. hydrargyri) can be improved by the substitution of one of the proprietary ointment bases, such as *resorbin or vasogen.* These are less greasy and odoriferous. One part of mercury may be rubbed into one or more parts of the base, or the preparation may be obtained ready made in 20-per-cent and 50-per-cent strengths. Put up in dram capsules (one for each rub) they are convenient to carry about.

Another new preparation is *calomelol ointment,* white in color, put up in graduated glass tubes, two of the "marks" to be used for each rub. It is cleaner than the blue ointment, and seems to be about as efficient and somewhat less irritating.

The Technic.—The best method is that employed at the Hot Springs. The patient takes a hot soap-and-water bath, is well rubbed down with alcohol, and then is ready for his inunction. He sits astraddle a chair with his face toward the back, his arms folded upon it and his chin resting upon his arms. An attendant now rubs in broadly and with a vigorous circular motion of the hand over the entire back a given quantity of mercurial ointment, generally one dram at a rub. The friction continues for twenty minutes. (To prevent mercurialization the frictioner may protect his hand with a rubber glove.) The ointment thus rubbed in is left upon the back, and the patient puts on first a thin gauze undershirt (which he wears a week as a "mercurial" shirt), and over this his ordinary undershirt and customary clothing. On the following

day the patient takes another hot soap-and-water bath, is thoroughly washed, rubbed with alcohol, and then takes another friction as on the previous day, resuming his mercurial shirt.

In case the patient has to do his own rubbing he cannot reach his back, and as no other part of the body is covered with skin sufficiently thick to bear daily rubs, he is obliged to shift from place to place. The hot bath, the alcohol rub, and the mercurial shirt are employed as in the above-described system, and the rubs are made in the following regions on successive days:

1. Right arm and forearm, internal aspect.
2. Left arm and forearm, internal aspect.
3. Right thigh.
4. Left thigh.
5. Right side of thorax and loin.
6. Left side of thorax and loin.
7. Abdomen.

The purpose in thus distributing the course is to make it occupy an even week. Hairy subjects may have to modify the plan.

The ointment must be rubbed into the skin until every bit of greasiness has disappeared. This takes about twenty minutes, and is a duty the patient is inclined to shirk.

Merits of Inunctions.—In efficacy inunction ranks below injection. In convenience it may rank higher, in that it can be performed by the patient himself. But the dosage is uncertain, for we do not know how much mercury is absorbed by the skin (or whether the absorption is not chiefly by inhalation of the mercury that evaporates from the surface of the body [1]), and very few patients rub in the ointment thoroughly.

But the chief objection to inunction comes from the patient. The treatment is dirty and disgusting; it often irritates the skin, and may even provoke a local eczema; it is tedious in the taking.

For these reasons I find that when I ask a patient to choose between inunction and injection he almost invariably selects the latter. And unless he is oversensitive to injections, I much prefer he should.

Fumigation

Salts Employed.—The salt of mercury most suitable for fumigation is the black oxid. About ʒij to ijss (8 to 10 gm.) of the salt should be used. The fumigations are usually repeated twice a week.

The Technic.—If the fumigation cannot be taken at a bath establishment, it may be taken at home with the aid of the following ap-

[1] This question has never been absolutely settled; but it would seem that with the ordinary method of inunction, fully as much mercury is absorbed by the skin as is inhaled.

paratus: a piece of tin, 10 × 3½ inches, bent to a right angle at 3 inches (more or less) from each end; a spirit lamp or Bunsen burner; a large pan of boiling water; a chair; a couple of large blankets or a vapor-bath cabinet. The patient strips and sits on a chair surrounded by the blankets or the cabinet, with his head out. Under the chair are placed the pan of steaming water, and beside it the spirit lamp covered by the bent tin, upon which the mercury is spread.

As soon as the body becomes warm and moist the spirit lamp is lighted, and the salt begins to volatilize. After fifteen minutes the heat usually becomes unbearable; the lamp may then be extinguished, but the patient should sit in the mercurial fumes ten minutes longer. Then he arises, wraps himself in a blanket, and lies down until he is cool. He should not take a bath until the following day.

Let him also take care not to burn himself to death.

Merits of the Method.—The difficulties surrounding fumigation are many. Very few patients will spend the time and trouble to take their baths at home, and I know of no bath establishment in New York where they are properly given. Yet the method is not painful like injection (and usually not quite so efficacious), more powerful and more cleanly than inunction. The danger of salivation is the same as with injections.

I use it quite frequently and with very satisfactory results in the most stubborn cases.

Intravenous Injection

Solutions Employed.—*Bichlorid.*—This salt, though subject to the criticism that it coagulates albumin, was employed by Bacelli and has been more used than any other.

Bacelli's formula is:

Hydrarg. bichlorid.	1 gm.;
Sod. chlorid.	3 gm.;
Aq. destillat.	1,000 gm.

Inject 1 c.c. daily.

Other Salts.—Barthélemy and Lévy-Bing have also employed the oxycyanid (1:1,000) and the biniodid (1, 2, or 3:1,000). They prefer the last.

Technic.—Abadie, one of the few avowed partisans of this method, advises the following technic:

1. He employs a syringe whose barrel and piston are both of glass (thus assuring absolute freedom from specks of dirt) and a fine needle. These he sterilizes by boiling.

2. He employs the oxycyanid (1:1,000), injects 1 c.c. every other day for twenty days (10 injections); then, after an interval of a fortnight, resumes this twenty-day course as often as necessary.

3. "Before injecting I distend the veins at the elbow by a ligature about the arm. I choose the (most prominent) vein (at the elbow) and, after careful antisepsis, insert the fine needle gently and obliquely into the center of the vein. The entrance of the needle into the vein imparts a characteristic sensation. The patient does not feel the least distress. The injection is made slowly after removal of the ligature. An antiseptic collodion dressing is applied and the patient returns to his work" (Abadie).

Complications.—The method appears to be less difficult and dangerous than one would expect. Such local inconveniences as ecchymosis, periphlebitis, nodosities, and subcutaneous edema would be pardonable were there any great advantage in the method; but this does not appear to be the case.

CHAPTER LXXIV

THE IODIDS—MIXED TREATMENT

When we speak of the iodids, we think of the iodid of potassium. This drug is worth more than all the others together. Occasionally the patient is so susceptible to its influence that some substitute has to be employed, but no effort should be spared to make the patient digest potassium iodid, so infinitely superior is it to all the other remedies claiming to be "just as good."

Therapeutic Indications.—Iodids are indicated in the treatment of:

1. Tertiary lesions.
2. Neuralgic or painful lesions, especially the pains of early secondary periostitis, arthritis, headache, etc.
3. Cases in which, on account of idiosyncrasy or severe nephritis, mercury cannot be borne.

IODID POISONING (IODISM)

Iodid poisoning shows itself in many forms. Among the commoner ones, often occurring in conjunction, are:

1. The metallic taste.
2. Coryza.
3. Acne.
4. Indigestion.

Among the rarer forms may be mentioned:

5. Various skin lesions.
6. Toxemia of the nervous type.
7. Salivation and congestion of the salivary glands.
8. Neuralgia.
9. Localized edema.
10. Epistaxis, urethritis, albuminuria.

Iodic Coryza.—This resembles a common cold in its milder forms; but when severe simulates the most violent hay fever; the "head is stopped up"; the eyes and nose run copiously.

Let the iodid be increased, and he actually passes through this, and at the higher dose shows none of the phenomena produced by lesser amounts. Yet, let the iodid be discontinued for a few weeks, and, on resuming its use, the patient has to go through precisely the same misery before reaching the higher dose, at which he no longer suffers.

Acne.—Pustular acne, usually upon the face, neck, shoulders, back, or buttocks, is extremely common. The eruption comes out in crops. The pustules may attain the proportions of little boils. Though annoying, the eruption is bearable. No treatment appears to influence it; but the pustules should be left undisturbed. The more they are pinched and squeezed the longer they last.

Indigestion.—This is the most annoying of the commoner forms of iodic poisoning, since it cannot very well be borne for any length of time, nor can it, like the coryza, be lived down.

This indigestion may merely amount to a little abdominal discomfort and a disgust for food. If the remedy is pushed, the patient's digestion goes all to pieces; he is nauseated, has cramps and diarrhea, and the iodid has to be stopped. If it is, nevertheless, brutally pushed, the patient's digestion may be damaged for years or forever.

Other Skin Lesions.—The rare skin eruptions due to iodism are *erythema,* which may be papular, commonly occurring upon the nose, cheeks, and forehead, and may become eczematoid; *papules or tubercles* (very rare); *purpura,* usually affecting the legs and occurring in the old and debilitated; *bullæ,* which usually occur on the face and extremities, and may be so umbilicated and so numerous as to suggest variola; a *pustulo-crustaceous* dermatitis (simulating syphilis), and various combinations of these varieties.

Toxemia.—Iodic nervous toxemia occurs under two types: In the *acute form,* due to a short course of heroic medication, the patient is overwhelmed by the drug and lies, stupidly drooling, unable to take nourishment, perhaps absolutely unconscious. Yet on stopping the drug the patient is up and about in a fortnight.

In the *chronic form,* due to prolonged administration of large doses, the symptoms are commonly mistaken for those of syphilis of the nervous system, with the disastrous result of encouraging the use of more and more iodid. I have seen several patients long under treatment by iodid for severe nervous lesions due to syphilis gradually become anemic, restless, nervous, despondent, tremulous, unable to eat, and apparently too weak to do any work. I have known two of them to give up work, and one of them prepare to die. One could not sign his name, so weak and unsteady was he, and yet both recovered in a few weeks after leaving off the iodid, going away from town, and resorting to general tonic measures.

METHOD OF ADMINISTRATION AND DOSAGE

The susceptibility of various patients to iodism differs widely. I have seen a single dose of iodid of potash (gr. v) cause the submaxillary glands to swell to the size of pigeons' eggs, and have record of several cases of facial edema and iodic erythema or urticaria following a similar dose.

But such cases are most exceptional. *As a rule,* the metallic taste, mild snuffles, and acne may be expected at a dose of gr. x to gr. xxv (0.6 to 1.6 gm.) three times a day, and indigestion at double these doses. On the other hand, the patient *may* take an ounce (30 gm.) a day with no inconvenience except a strong metallic taste.

Yet there is always some doubt at first as to how well the patient will digest the iodid, and, accordingly, its administration is always surrounded with many precautions.

The One Hundred-per-cent Solution.—The preparation commonly employed is the "saturated solution" of iodid of potassium given in drop doses. But there are two terms here which may be misinterpreted: *What is a "saturated solution"? what a "drop dose"?*

If you simply prescribe "a saturated solution," the pharmacist may take you at your word and compound a mixture containing 120 per cent (or more) of potassium iodid. This is precisely what you do not wish. *You wish a 100-per-cent solution.* To avoid error, therefore, always write as follows:

℞ Potass. iodid. ..... ℥j (30 gm.);
Aquæ .....q. s. ad ℥j (ad 30 c.c.).

The Minim Drop.—In the second place, the droppers of commerce vary in size as well as shape, and none of them drop minims. Therefore, the drug must be dispensed in a *dropper bottle* (which drops minims) or accompanied by a *minim graduate.* The dropper bottle is better adapted to small doses, the graduate to large ones. The patient will find it convenient to measure out in the morning such doses as he is to take during the day while away from home, and carry them about in small vials or in a graduated bottle.

It may be more convenient to use *tablets* (gr. v) of iodid, but the solution seems to be less poisonous.

The Time of Administration.—Iodid is better borne if administered on a relatively empty stomach. Three hours after meals (e. g., at 11 A.M., 4 and 9 P.M.) is the ideal time. But this is so inconvenient an arrangement that I have most of my patients take it on arising, half an hour before lunch, and on retiring (or a fourth dose may be inserted half an hour before dinner). But many persons can take it at any time.

The Dilution.—The iodid must always be diluted. The administration of an undissolved tablet will give most people heartburn for hours.

As far as possible,[1] one should make it a rule to dissolve no more than ʒss (2 gm.) of the salt in a single tumblerful of fluid, while even the smallest dose merits at least half a tumblerful.

The Diluent.—If the patient can digest milk, this is much the best diluent, gaseous waters are the second choice, plain water the third choice. For a continuous course, it is well to suggest an occasional change of vehicle.

Any other fluid, such as coffee or tea, may be employed if the patient prefers, and if it may be drunk in sufficient quantity to effect the desired dilution.

Prevention of Iodism.—So common are the annoyances of iodism that innumerable remedies have been devised to prevent them. These may be divided into two classes:

1. Methods of taking potassium iodid.
2. Substitutes for potassium iodid.

Methods of Taking Potassium Iodid.—The best way to make iodids agree with the patient is to put him in bed on a milk diet.

In order to aid the digestion of iodids, 10 drops of dilute hydrochloric acid after meals is often helpful. The combination of Tr. nucis vomicæ (or of tincture of belladonna or of arsenic) with each dose of iodid is well spoken of; but they have been of no use at my hands.

Iodid of potassium may be administered *per rectum:* ʒij to iv (8 to 16 gm.) in ℥vj (200 c.c.) of peptonized milk. But this method is not very efficient, and can be used for only a short time. The iodid is not suitable for hypodermic medication.

Substitutes.—*Atkinson's Iodid.*—The iodid made by Atkinson is far less poisonous and quite as efficient as other forms of potassium iodid.

Sajodin.—This is less poisonous, but less efficient.

Iodipin and Lipiodol.—Iodipin for internal administration contains 10 per cent iodin in oil; a 25-per-cent solution is used for intramuscular injection (dose, ʒss to j = 2 to 4 gm.). Lipiodol is a similar but stronger preparation; it contains 40 per cent iodin. Both of these preparations may be used freely by injection. Iodipin is employed constantly at Aachen. I have not tried it fairly; but have used the lipiodol in doses of ʒss to jss (2 to 6 gm.). These enormous doses of a thick oil when plunged into the gluteal muscles actually cause far less pain, on the average, than any injection of mercury I know. A distinct iodic effect may be obtained by these injections, but I have yet to prove that they are as effective as potassium iodid by mouth.

[1] The limit with high doses being the number of glasses of fluid a patient can drink.

Dose.—What is the dose of potassium iodid? It is never twice the same. Fournier is surely wrong in asserting that less than 5ss (2 gm.) of iodid a day is always futile, and equally wrong in the statement that "what a dose of 10 grams (a day) will not achieve no higher dose will achieve." Five grains three times a day may perfectly well cure a lesion, and it is the proper dose to begin with, for one should always be on the lookout for idiosyncrasy. But if the patient can take 5 grains, he can take 10, and usually 20. Accordingly, *10 to 20 grains three times a day is the average dose required.*

But to conquer the lesion it may be necessary to go higher, and if the lesion is in the nervous system, to go very rapidly higher. Where shall we stop? at a theoretic 10 grams? No, nor at 20. Under urgent conditions the dose must be rapidly increased even in the face of severe poisoning.

Herein lies the great difference between the use of iodid and that of mercury. *If mercury poisons, it must be stopped at once. But if iodid poisons, it may still be pushed—in some cases it must be pushed*—for iodism is but a slight and temporary inconvenience compared with the destructive syphilitic lesions against which iodids are employed. Generally speaking, therefore, *the limit to the dose of iodids is marked by an improvement in the lesion; they must be pushed until the lesion begins to yield.*

Duration of Treatment.—For stubborn lesions, however, this doctrine may be followed too literally. Lesions of the nervous system, because of their peculiar stubbornness, are likely to be overtreated unless a time limit is set to the course. This subject is amply discussed elsewhere (p. 758). Suffice it to say that a *severe course of iodid should not be continued more than three or four weeks.* Whether the lesion has yielded or not, an intermission of at least two or three weeks for purely hygienic treatment should then follow, after which another short, sharp course of iodid may be begun.

How to Increase the Dose.—One usually begins with 5 minims of the "saturated" solution three times a day. The dose is increased 1 or 2 minims a day [1] until 15 minims is reached. Thereafter the increase may be more rapid, from 3 to 5 minims a day; and after the doses reach 25 minims each, from 5 to 10 minims a day. By this course it takes from three to five days to reach a 10-minim dose, and from six to twelve days to reach a 20-minim dose.

But if there is need for haste such slow and cautious measures must be discarded. Suppose you are called to treat a case of syphilitic hemiplegia that has just occurred. It may be that low doses would cure, but you have no right to take the chance. You must begin with 10-minim

[1] If one minim, ♏ vj, t. i. d. the second day; ♏ vij, t. i. d. the third day, etc.

doses at least four times a day, and increase 10 or 15 minims a day until 40- or 50-minim doses are reached. Here you may pause for a few days, hoping the symptoms will improve. If they do not, push on, increasing by 10-minim bounds until either the lesion yields, or the patient is utterly iodized, or the time limit of four weeks is up. Then, after an interval, a secondary course is begun, but it need rarely be made as severe as the first.

MIXED TREATMENT

Thus far I have spoken of iodid as though used alone, and as a matter of fact it is often so employed. But it is my practice *never to use iodid without mercury.* My reason for this is that, *though the iodid may be somewhat efficient alone, its efficiency is greatly enhanced by the use of mercury.*

This treatment of syphilis by mercury and iodid together is called mixed treatment. The two are ordinarily given together in the following formula:

℞ Hydrarg. chlorid. corrosiv. . gr. j to ij (0.6 to 1.2 gm.);
Potass. iodid. ..... ʒij to ℥j (8 to 30 gm.);
Syr. sarsaparillæ comp. . . ad ℥jv (ad 130 c.c.).
M.
S.—Teaspoonful two hours after meals.

The dose may be and usually is given immediately after eating, but it is better digested if given two hours later.

In the above formula the *mercury biniodid* may be substituted for the bichlorid, in half the dose.

If the patient refuses to take a fluid medicine he may take his iodid as a tablet half an hour before meals and the mercury pill or tablet after meals. The mixed-treatment pills or tablets put up by various drug houses have not given me much satisfaction.

But when the gravity of the lesion demands hasty or energetic treatment, or when, as in the case just recited, the condition of the patient's digestion prohibits internal treatment, the mercury must be given by injection, fumigation, or inunction, the iodid by saturated solution or injection (iodipin, lipiodol).

CHAPTER LXXV

SYPHILIS OF THE SKIN: GENERAL CHARACTERISTICS; SECONDARY SYPHILIDS—SECONDARY SYPHILIS OF THE MUCOUS MEMBRANES

SYPHILIS OF THE SKIN

Syphilitic skin lesions are marked by certain general characteristics that serve to identify them from other similar nonsyphilitic lesions. The diagnosis of any given syphilid is founded largely on these characteristics.

General Clinical Characteristics

1. Progressive development.
2. Polymorphism.
3. Absence of local, general inflammatory reaction.
4. Absence of pain and itching.
5. Peculiar raw-ham color.
6. Rounded form.
7. Scales white, superficial, nonadherent.
8. Crusts greenish or black, thick, irregular, adherent.
9. Ulcerations rounded or circinate, with abrupt edges, sanious secretion, and sluggish base.
10. Scars round, depressed, thin, nonadherent, smooth, often pigmented at first.
11. Early eruptions disseminated and profuse, later ones asymmetrical and grouped.

Progressive Development.—With various degrees of speed, but, as a rule, slowly and gradually, the eruption spreads. The superficial general eruption spreads by the appearance of new lesions; the later single lesions by encroaching on the surrounding tissues.

Polymorphism.—The early, general eruption develops progressively in type as well as in multiplicity of lesions. Thus a general, papular eruption a week old may show macules, papules, tubercles, vesicles, pustules, and minute ulcers irregularly intermingled. Such is polymorphism. It is all but pathognomonic of syphilis.

The later the eruption the less polymorphic it is likely to be.

Absence of Inflammation.—Fever very rarely accompanies a syphilitic eruption. Exceptions, chiefly due to absorption from mixed infection of a pustular syphilid, are so few as to be negligible.

Neither is tenderness, heat, nor inflammatory congestion discernible in the lesion itself.

Absence of Pain and Itching.—The syphilitic lesion as such is painless. In those exceptional instances (and they are singularly rare) of mixed infection with the ordinary pyogenic microbes, the pain is due to the adventitious inflammation.

Moreover, the syphilid does not itch. A little tingling may accompany the relatively rapid development of a diffuse exanthem, but even this is rare and does not amount to a real itch.

Peculiar Color.—The color of the syphilids is not a frank, inflammatory red, but a vinous, empurpled redness, resembling, when well marked, the raw meat of ham. This color is found also in many of the gouty, papular eruptions and in psoriasis, rarely in other eruptions. The color of the syphilids passes by pigmentation from this dusky red into a yellowish copper color, and sometimes by a deep pigmentation to brown or black, the skin around the lesion (areola) being usually also pigmented to a certain extent. This pigmentary coloration sometimes lingers for years, but usually clears off after a few months, disappearing first centrally, then peripherally. Finally, the spot becomes brilliantly white.

Rounded Form.—Every syphilid is composed of circular lesions. If discrete, as in most of the earlier eruptions, the individual lesions are manifestly round. But many of the later lesions are confluent. Either because the lesions begin so close together or because in spreading they invade the same territory, the resultant lesion is a composite one, and this may show a *circinate,* polycyclic edge, which is very characteristic.

Moreover, although the disposition of the first general eruptions is diffuse and irregular (though symmetrical), *the lesions composing later eruptions are often distributed in circles* or in segments of circles.

Finally, certain of the more chronic syphilids as they progress extend in every direction toward the periphery, healing at the same time in the center. Hence result lesions of a circular or circinate or horseshoe shape quite pathognomonic. Such eruptions are called serpiginous.

The Scale.—The scales on the cicatrices and on the patches of scaly, syphilitic eruptions are thin, white, nonadherent, lamellar; very different from the dense, thick, imbricated, adherent scales of psoriasis.

The Crust.—The scabs formed on syphilitic ulcerative, rupial, and pustular lesions are rough and adherent, dark brown, or greenish black, sometimes loosened by an underlying accumulation of pus, but more

often seemingly set into the skin, and tightly adherent. They may be of light color over secondary pustular lesions, but, light or dark, the green hue is rarely totally absent and is often brilliantly marked.

The Ulceration.—With the exception of the chancre and of the ulcerated mucous papule (both of which may vegetate and are usually elevated rather than depressed), the ulcerations of syphilis resemble chronic, indolent ulcers. They are rounded or oval, with abrupt edges cut away like those of a chancroid; the base is covered with yellowish, false membrane, sometimes bluish, like boiled sago. The edges and base of the ulcer are usually hard, and the former generally, but not invariably, firmly adherent and not undermined, as in the ulcerations of tuberculosis. These ulcers do not bleed easily, are generally atonic and sluggish, and usually entirely painless. Apparent exceptions to the rule in regard to pain are often due to the dependent position or other cause calculated to excite inflammation, or to the situation of the ulcer over a bone, the periosteum of which is inflamed and painful.

The Scar.—The cicatrices of such syphilitic lesions as have destroyed tissue (i. e., tertiary lesions), whether there has been surface ulceration or not, are rounded, very thin,[1] depressed, smooth, shining, and non-adherent. They are *often at first uniformly pigmented* of a dark-brown hue (nearly black in brunettes). This pigment clears off from the center to the circumference until only a dark border is left, which sometimes lasts for years, but finally the whole cicatrix acquires an almost pearly whiteness (though the pigmentation may persist indefinitely).

General Clinical Characteristics of Secondary and Tertiary Syphilids

Certain general clinical characteristics distinguish the secondary from the tertiary syphilids.

The *secondary lesions* are:

1. Superficial, benign, resolutive.
2. Multiple, profuse, or even generalized.
3. Irregularly disseminated, but usually symmetrical.
4. Polymorphous.
5. Curable by mercury.

The *tertiary lesions* are:

1. Deep, destructive, and malignant.
2. Few in number, often single.
3. Distributed in circles or segments of circles, and usually asymmetrical.
4. Usually monomorphous.
5. Usually, though not always, require mixed treatment for a cure.

[1] Marked only with the slightest irregularities (like cigarette paper).

Secondary Syphilids

The secondary syphilids affecting the general integument may be discussed under the following heads:

Macular syphilids.
Papular syphilids.
Syphilitic alopecia.
Pustular syphilids (including crusted and ulcerating lesions).
Squamous syphilids.
Pigmentary syphilids.

Fig. 137.—Macular Syphilis. (Fox.)

Macular Syphilid.—General Macular Syphilid.—This eruption, often called the syphilitic roseola, is usually the first secondary eruption of the disease. It is made up of macules of various sizes. It is

usually most marked on the flanks; may cover the whole body; is extremely rare on the face and hands. If untreated, it disappears in two to six weeks.

Late, Circinate, Macular Syphilid.—Relapses of macular syphilid assume a distinctly circinate form; it is, as it were, the shadow of a circinate tubercular lesion.

The Papular Syphilids.—The Papule.—The syphilitic papule is very slightly elevated above the surface of the skin. It varies from the size of the head of a pin to that of a split pea. Its summit is flat, though, if the papule be very small, this feature may be lacking. Its shape is absolutely and characteristically circular; its color, at first

Fig. 138.—Papular Syphilid: Confluent on Face. (Fordyce.)

pink, soon takes on a purplish, ham, or copper hue, although quite frequently this is not marked, but may be intensified by pressure. Its surface is shining and tense, and this may be covered by a slight, thin

scale, or, more commonly, this scale is promptly shed, leaving a faint, scaly collar around its base. The papule is hard, and has in some measure the induration characteristic of all syphilitic exudates. From the papule all the other elements of secondary skin syphilis arise, and in the earlier, papular eruptions, it is not uncommon to find admixtures of pustules, squamous papules, etc.

Papular Eruptions.—The papular syphilid may be general and disseminated or partial and scattered. In a certain proportion of cases the general macular or papular eruption is preceded by the appearance of a few scattered papules. As a rule, however, the first papular eruption is generalized.

Relapsing papular eruptions tend to be more closely confined to certain (indeterminate) regions the later they occur. As a rule, however, the papules are not grouped in any geometric figure; they remain disseminated. Even those later papular eruptions are often bilateral and symmetrical.

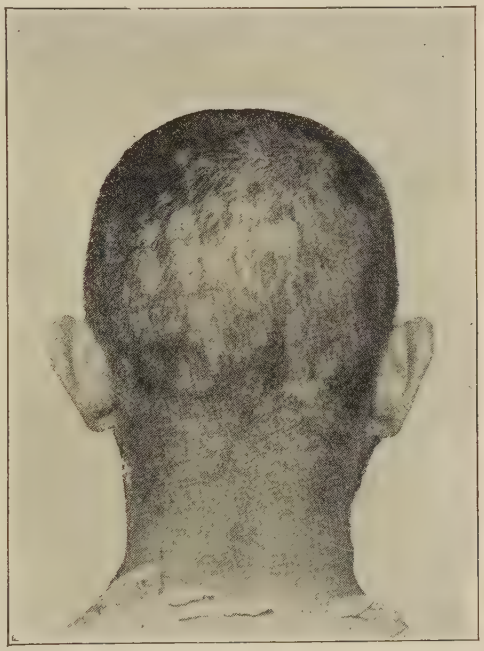

Fig. 139.—Syphilitic Alopecia. (Pusey.)

Syphilitic Alopecia.—Alopecia is not a common feature of syphilis. A general falling of the hair may accompany the first outbreak of the disease; but this is noticeable only to the patient himself. Much more characteristic but quite rare is the "moth-eaten poll" illustrated in Fig. 139. These types of alopecia are temporary. Syphilis does not cause true baldness.

The Pustular and Crusted Syphilids.—The pustular syphilids are all (excepting the crusts in the scalp) rare secondary lesions. Pustulation is, generally speaking, excited by dirt and debility. It is, therefore, properly regarded as an evil omen.

The pustule is, as it were, superadded to a syphilitic papule and sits upon it, destroying but little tissue, and hence leaving little or no scar. Pustular lesions may be scattered among the papules of a polymorphic eruption, but the more notable pustular eruptions are those which follow given types and mimic certain nonsyphilitic eruptions. Accordingly we distinguish:

Herpetiform syphilid.
Varicelloid (or varioloid) syphilid.
Acneiform syphilid.
Impetiginous syphilid.
Ecthymatous syphilid.

The titles sufficiently describe them.

The Squamous Syphilids. — **Generalized Squamous Syphilid.** — This eruption occurs in two varieties—as a guttate or diffuse psoriasis and as a circinate eruption. The character of the eruption is the same in each. They may be seen together on the same subject.

Diagnosis.—When not associated with other specific lesions, the squamous syphilid is often difficult to distinguish from *psoriasis.* Much light is thrown upon such cases by study of the previous history. Psoriasis tends to cluster about the elbows and knees and upon the scalp, and practically *never affects the palms and soles;* its scales are thick, imbricated, tightly attached, and lying in several layers, so that it is diffi-

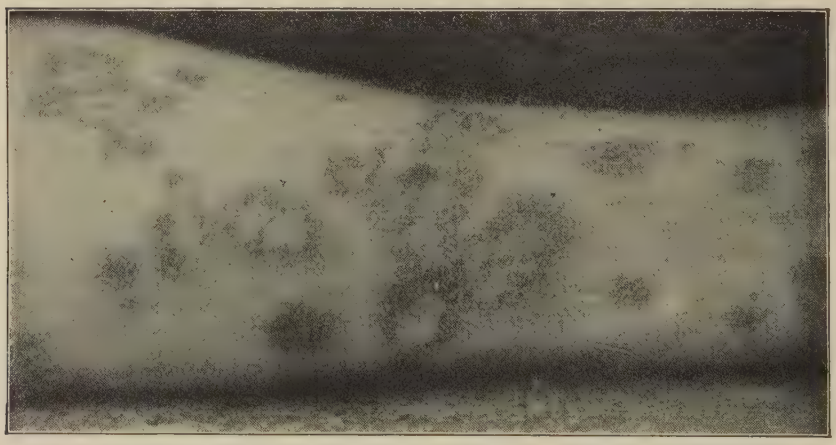

Fig. 140.—Circinate Papulo-squamous Syphilid of Forearm. (Fordyce.)

cult to scrape them all away and get down to the livid redness of the patch beneath; and when the scales are all rudely rubbed off the patch is very apt to bleed.

Squamous Plantar and Palmar Syphilid.—If the eruption is seen when it first comes out, its papular quality may be readily recognized in the manifest, individual papules or in the sinuous line of confluent papules. But in an aged lesion, even if it be only a few months old, the papules may almost entirely disappear, and all that is left visible is the squamous almost scarlike change.

In this condition the eruption may continue active and spreading in a circinate way for many years, during which time an occasional

papule may become visible, or the confluent red ribbon may show itself here and there. But the general characteristic of the eruption is a purely scaly one. The scales follow one of two types. In the more common form they produce glistening psoriatic or eczematous-looking

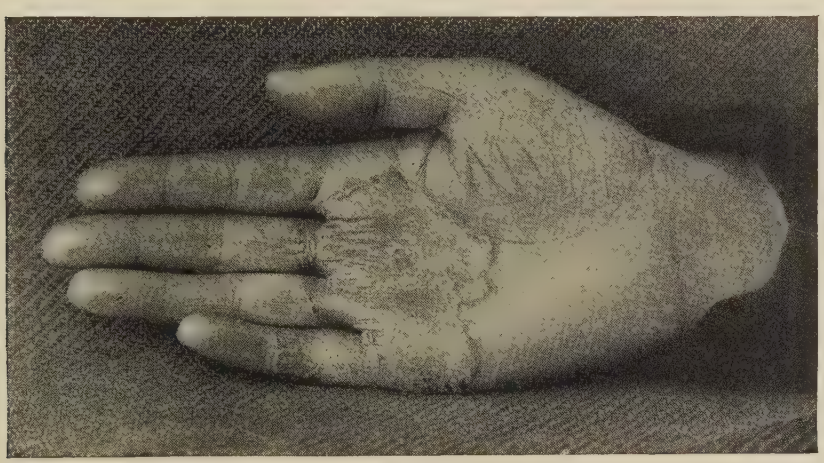

Fig. 141.—Squamous Syphilid of Palm. Note circinate border and absence of definite papules. (Fordyce.)

spots. Less often and almost exclusively on the feet they heap up in a great callus.

The Pigmentary Syphilid.—This extremely rare eruption usually appears as a reticular brownish patch upon the neck. It is extremely slow to disappear.

SECONDARY SYPHILIS OF THE MUCOUS MEMBRANES

Distribution.—They may affect any part of the mucous membranes and also any part of the skin which in texture and moisture simulates the physical conditions of mucous membrane. They are commonest in the mouth and throat and in and about the genitals.

Etiology.—Local irritation is the exciting cause. In the mouth the local irritation of tobacco, whether smoked or chewed, stands preëminent. About the folds of the skin uncleanliness excites them. In the male they are more common in the mouth than elsewhere; in the female, much more common about the genitals on account of the profuse secretions there.

Classification.—The secondary syphilids of the mucous membranes may be classified as follows:

1. Macular syphilid.
2. Erosive or papulo-erosive syphilid (mucous papule).
3. Ulcerative syphilid.
4. Squamous syphilid.

Of these, the macular syphilid is unimportant. The erosive papular and ulcerative types are common in the first year of the disease and occur infrequently for several years thereafter, while the squamous types are rarely seen before the second or third year, and may continue indefinitely thereafter.

The Erosive or Papular Syphilid.—The syphilitic papule upon a moist skin or mucous-membrane surface is always eroded. Even upon a dry surface it sheds the superficial epithelium, and, when kept moist, the deeper layers are more freely exposed and exudation from the surface of the papule is thus a constant phenomenon in all papular lesions of mucous or moist surfaces.

The early erosive papular lesion may be so slight as to produce no perceptible irregularity in the surface. Its top is level with the surrounding mucous membrane, but it is an eroded top, and, consequently, the papule appears as a simple erosion. In a second type the papule is elevated above the surface to a slight degree and becomes a typical, eroded papule, while in the third type it is hypertrophic and becomes a vegetating papule or condyloma. Hence the three types of erosive papular syphilids:

The erosion.

The eroded papule.

The vegetating papule or condyloma.

The Condyloma.—The striking characteristic of this lesion is that, though a vegetating one, the vegetation is relatively low compared to the extent of a base; hence, it is commonly known as *condyloma latum*. Its foul secretion, its irregular, broken, vegetating, and eroded red surface constitute amplifications of the characteristics of the eroded papule.

The Ulcerative Syphilid.—Just as the papule may appear as a simple erosion, an irritated papule, or a hypertrophied papule, so the ulcer may appear as a *simple ulcer,* as an *ulcerated papule,* or as an *ulcerated hypertrophied papule.*

Leukoplakia.—By leukoplakia (tylosis, milk spot, etc.) is meant a chronic inflammation of the mucous membrane characterized by the appearance of pearly-white or bluish-white patches. These patches may appear anywhere inside the mouth, but, while extremely common upon the tongue, they are very rare elsewhere. I have record of only seven cases occurring on the tongue thickened by sclerotic glossitis, or (rarely) destroyed by gumma.

Prognosis.—Leukoplakia is one of the most inveterate lesions of syphilis. Cases lasting four or five years are not uncommon, and one occasionally sees them continue for ten or twenty.

The most important question in the prognosis of leukoplakia is the occurrence of *epithelioma.* Most authors speak of it as common. But

among my cases I have known only two to undergo epitheliomatous change.

Diagnosis.—I know no pathognomonic characteristic to distinguish the ulcer of syphilis from that of mercury, but the latter rarely occurs upon the fauces or upon the dorsum of the tongue or in the angle of the lips, where syphilitic ulcers are common; while *it is almost typical of mercurial ulceration to find a lesion on the cheek or gum back of the last molar tooth, or about the upper or lower central incisors.*

Vincent's angina may be mistaken for either a primary or a secondary syphilitic mouth lesion. The microscope makes the diagnosis.

Treatment.—*Local Treatment of Lesions upon the Skin.*—If the lesion is upon the skin it is usually possible to keep it dry, and this drying will cure *erosion or vegetation* as if by magic. In mild cases all that is necessary is to cleanse the affected region thoroughly twice a day with warm soap and water, then dry and apply pure calomel or calomel mixed in equal parts of stearate of zinc or talcum.

For extensive condylomata it may be necessary to paint with a solution of permanganate of potash (1:1,000) twice a day and to interpose a layer of absorbent gauze between the various inflamed surfaces after powdering the whole region thickly.

Local Treatment of Lesions within the Mouth.—The most important point in local treatment is mild cauterization, and the best cauterizing agent is the officinal *liquor hydrargyri nitratis,* either pure or diluted to one half or one quarter strength. The pure fluid can be applied only to small lesions, as it is quite painful. *This application should be made not oftener than twice a week,* and should never be confided to the hands of the patient, since overcauterization makes the lesion worse instead of better.

The *nitrate-of-silver* stick often acts quite as well as the acid nitrate of mercury, and like it may be applied twice a week.

In order to prevent relapses of secondary syphilids within the mouth, it is often necessary for the patient—

To stop smoking and chewing tobacco;

To keep the teeth and gums in perfect condition;

To employ an antiseptic mouth wash.

CHAPTER LXXVI

TERTIARY SYPHILIDS OF THE SKIN AND UPPER RESPIRATORY TRACT

The syphilitic tubercle is to tertiary skin syphilis what the papule is to secondary skin syphilis.

The pathological difference between papule and tubercle consists in this: The papule is an exudation rather *upon* than *in* the true skin. It does not destroy any of the tissue of the skin, therefore it does not leave a scar. The tubercle, on the other hand, is an exudation within the derma which, upon healing, leaves a permanent scar.

Tertiary syphilids of the skin are made up of various tubercular, tuberculo-pustular, tuberculo-ulcerative lesions, and of gummatous lesions. "The tubercle may be described as a gumma of the skin, and, conversely, the gumma as a deep tubercle of the connective tissue" (Morrow).

Thus tertiary syphilids may be divided as follows:

Tubercular lesions.

Tuberculo-ulcerative lesions, and

Subcutaneous gummata.

TERTIARY SYPHILIDS OF THE SKIN

The Tubercular Syphilid

The nonulcerative, tubercular syphilid occurs under two forms:

The disseminated tubercular syphilid, and

The grouped tubercular syphilid.

Either of these may be scaly upon the surface (tuberculo-squamous).

The tubercles are usually small. Their favorite positions are on the forehead (circle of Venus), the lips, the back, the leg, the outer surface of the forearm, and the back of the shoulders. A single tubercle may constitute the whole eruption, or there may be great numbers of them.

Grouped Tubercular Syphilid.—The favorite locations for the grouped lesions are those just mentioned.

The grouping occurs in three forms:

1. The discrete form.
2. The confluent, circinate form (Fig. 142).
3. The massed form.

If *discrete,* the tubercles appear to be ranged in circles or in arcs of circles, forming a polycyclic or circular design. If *confluent* they form sinuous scalloped figures, or else a solid, rounded, indurated *mass.*

Fig. 142.—Confluent Tubercular Syphilid of Nose. (Fox.)

The Ulcerative Tubercular Syphilid

The tertiary ulcerative skin lesions have certain characteristics in common:

1. *The individual tubercles are quite large.*
2. *They may become serpiginous;* that is to say, the ulcers and tubercles creep over the surface. The advance may be centrifugal in all directions or along a narrow track in curves, inclosing portions of

healthy skin; or the advance takes place in only one direction, while the opposite edge of the ulcer is cicatrizing.

Thus the *serpiginous ulcer* is usually a flat plane of scar tissue more or less completely surrounded by a ditch of ulceration set in an indurated syphilid as a base.

Fig. 143.—Serpiginous Tuberculo-ulcerative Syphilid. (Fox.)

3. *They may be phagedenic.* Phagedena is malignant, rapidly spreading gangrene.

It may spread chiefly over the surface (superficial phagedena); or may eat its way deeply into the underlying tissues (deep phagedena).

The course of phagedena is most capricious. Even when untreated its rapid spread will suddenly stop and the slough will be cast off and the lesion go on to heal; or, having stopped, it may take a new start.

Treatment.—Thus one can never be sure of the effect of treatment. When the gangrene is controlled there may be room for doubt whether it would not have ceased spontaneously quite as soon. Indeed, the Viennese school attack phagedena solely by hygiene and tonics, reserving mercury and the iodids for the cure of the ulcerated lesion left after the slough has been shed.

I have always thought, however, that high doses of iodids help to control phagedena, and, in attacking it, it has been my custom to push this drug rapidly to the point of saturation.

Characteristics of the Lesion.—The ulcerative tubercular syphilid may appear clinically as a *pustular,* a *crusted,* or an *ulcerating* lesion. Pustules are infrequent and rapidly break to take on one of the other types. Whether the lesion is crusted or ulcerated depends largely upon the accident of its situation. Usually it will be found covered with a typical syphilitic scab (p. 779); but if it has recently been picked or if it lies in some place subjected to constant friction, the scab may be off and a typical syphilitic ulcer (p. 780) disclosed.

Thus the lesion may appear in one of the following forms (we give only the most important ones, since they are useful merely for clinical identification):

Tertiary ecthyma.
Rupia.
Other forms of crusted syphilids.
The ulcerated syphilid.

Subcutaneous Gumma

The gumma begins as an insensitive, little, hard subcutaneous lump, freely movable over the subjacent tissues, the integument slightly movable over it. In this condition it may remain stationary for months, but, as a rule, it grows slowly (or rapidly) in size, and within a few weeks has infiltrated the skin.

The skin becomes red and tense, then, as the gumma begins to soften centrally, purple, boggy, and *tender to pressure.* Actual fluctuation may be determined and may cover quite a large area. As the tenderness continues, and may even be accompanied by intense pain, incision is often practiced to relieve these symptoms. The result is startling. Instead of a gush of pus there oozes forth only a few drops of bloody or purulent serum; the fluctuation persists; the symptoms are unabated; the incision has merely produced a gummatous ulcer.

The gummatous ulcer resembles the ulcerated tubercle, but it is deeper and its base is more sloughy.

Diagnosis.—Gumma may be mistaken for varicose ulcer of the leg.

FIG. 144.—GUMMATOUS ULCER: TIBIAL NODE. (Fordyce.)

SYPHILITIC LEG ULCER	VARICOSE LEG ULCER
1. *Situation.*—Anywhere. Often in calf or in upper half of leg.	1. Only in lower third of leg. Habitually on internal surface.
2. *Number.*—Often multiple.	2. Very rarely multiple.
3. *Shape.*—Round or polycyclic.	3. Irregular.
4. *Edges.* — Sharp, deep, or even undermined.	4. Rounded, shallow, never undermined.
5. *Surrounding Tissues.* — Very slight areola, unless there be old scars or other foci of syphilitic infiltration.	5. Extensively and irregularly pigmented, thickened, and adherent.

Besides this, there is on the one hand a history of syphilis, on the other varicose veins.

TERTIARY LESIONS OF THE UPPER RESPIRATORY TRACT

Diffuse Sclerotic Glossitis

The lesion is a diffuse sclerosis in the muscle of the tongue. It is quite rare and is always accompanied by superficial glossitis, either simple depapillation or leukoplakia.

Gumma of the Tongue

Gumma of the tongue is relatively rare. One third of the cases are associated with sclerosis of the tongue.

EPITHELIOMA	GUMMA
1. *Occurrence.*—Almost exclusively in men over forty-five years of age.	1. Any age; either sex. History of previous syphilis.
2. *Situation.* — Usually on edge; may be on under surface.	2. Usually on dorsum. Never on under surface.
3. *Number.*—Single.	3. May be multiple.
4. *Leukoplakia.*—May precede.	4. May accompany.
5. *Characteristics.*—A shallow, fungating ulcer, with thick, everted edges, upon a base of wooden hardness. It bleeds very readily; its discharge is foul.	5. A deep, sloughing ulcer, with sharp, undermined edges, upon a moderately indurated base. It does not bleed readily; its discharge is not very foul.
6. *Pain.*—Severe and lancinating.	6. Slight or absent.
7. *Lymph Nodes.*—Soon and progressively enlarged.	7. Enlargement slight or absent.
8. *Biopsy.*—Epithelial pearls.	8. Gumma.
9. *Treatment.*—No medicines have the least effect.	9. Mixed treatment cures.

Ulceration of the Palate and Velum

The typical and terrible lesion of syphilis is *the phagedenic gummatous ulcer.*

This begins as a diffuse infiltration, producing redness, tumefaction, and relative immobility of the velum. But it causes scarcely any pain, and the patient usually pays no attention to it until, suddenly, ulceration and phagedena set in.

The onset of phagedena is exceedingly rapid. The patient goes to bed at night thinking himself well, and awakes with a hole in his palate, or with great patches of necrosis replacing what the day before was a comparatively innocent, painless infiltration. Even now the pain is not great, and the discomfort is inconsiderable. But the foul odor from the sloughing tissue, or the sense of a hole in the velum, soon brings the patient to his physician.

Examination then reveals either an area of dark greenish slough in the palate, or else a perforation surrounded by a slough. If the perforation is of any size the voice assumes a nasal quality and the breathing may be accompanied by a rattling gurgle, due to the flapping to and fro of partially detached bits of the palate. When the patient tries to swallow he has great difficulty in preventing fluids from regurgitating through the perforation into his nose.

Gumma of the Nasal Septum

Gumma of the nasal bones is always insidious and rapidly destructive in its onset, like that of the palate and the velum.

The septum is the part usually involved.

The first symptom noticed by the patient is an increase in the discharges from his nose and the presence of blood in these discharges. He will also confess that the sense of smell is either blunted or completely lost.

Examination (anterior rhinoscopy) reveals a perforation in the septum, which is usually situated at least an inch from the anterior nares, though it may appear at the junction of bone and cartilage. This perforation is either surrounded by a sloughing sore or else plugged with scabs and dead bone.

Severe or neglected cases go on to total destruction of the nasal septum, and may be identified the moment they enter one's office by the peculiar snuffling, purring sound, due to the flapping of necrotic tissue excited by the breathing.

With the healing of such a lesion the bridge of the nose sinks in, and may even fall flat to the level of the patient's face if all the bones have been destroyed.

Syphilis of the Internal Ear

The lesions of syphilis in the inner ear are not well known. Indeed, the one symptom is *deafness,* without any local evidences of the disease.

This deafness is usually sudden in onset and complete. The prognosis is bad; the *treatment* by pilocarpin, mercury, and iodids.

Tertiary Syphilis of the Larynx

The tertiary lesions of laryngeal syphilis are:

Ulceration.
Gumma.
Fibroid degeneration.
Perichondritis.
Paralysis.

The common symptom is painless chronic aphoria, the *vox rauca syphilitica.*

CHAPTER LXXVII

SYPHILIS OF THE NERVOUS SYSTEM, THE EYE, THE BONES, THE VISCERA, AND OTHER REGIONS

SYPHILIS OF THE NERVOUS SYSTEM

Grouping the lesions of syphilis according to the tissues involved, one may affirm that syphilis of the skin is the most frequent, syphilis of the mucous membranes the most infectious, syphilis of the nervous system the most malignant manifestation of the disease. Syphilis of the nervous system is indeed malignant in that it occurs in a large proportion of syphilitics and that its lesions are always grave and often incurable.

Thus, among my 2,500 cases, 504 (20 per cent) were afflicted with syphilis of the nervous system, and of all patients showing tertiary and parasyphilitic lesions, 42 per cent were affected in the nervous system.

Pathology.—The prime lesions consist of:

1. Syphilitic arteritis, and
2. Syphilitic meningitis, a diffuse or a gummatous infiltration.
3. There is lymphocytosis of the cerebro-spinal fluid.

The cytological and biochemical changes usually found in the cerebro-spinal fluid of known syphilitics are identical with those usually found in tabetics and paretics, while differing from those common to other diseases of the nervous system.

Symptoms.—Apart from this early secondary meningitis, the lesions of syphilis of the nervous system have two striking clinical characteristics, viz.:

1. The occurrence of prodromes.
2. The variety and diversity of symptoms.

Prodromes.—There are five types of preliminary symptoms, one or all of which invariably, or almost invariably, precede the graver forms of cerebral or spinal syphilis. These are:

1. Pain.
2. Intellectual and moral derangements.
3. Impairment of the general health.
4. Impairment of the sexual power, and
5. Fugitive nervous symptoms.

The pain is usually much more marked by night than by day. It yields to nothing but iodids.

Duration of the Preliminary Period.—These warning symptoms may be few and brief, or multiple and prolonged. Severe syphilitic headache or repeated attacks of vertigo may continue for months, uncontrolled by treatment, and without leading to any further evidence of cerebral syphilis. But in a majority of instances the warnings are so few and so slight that the patient does not consult a physician until the full attack has burst upon him.

Onset.—In spite of prodromata the onset of symptoms is always sudden. The patient's story is that "suddenly—" something happened. Be the attack a dementia, a paralysis, or a convulsion, it develops suddenly, and to the untrained observer unexpectedly.

Course.—The course of the manifestation is, as remarked above, characterized by a marked—even pathognomonic—variety of symptoms dependent upon the diversity and irregular distribution of the lesions from which they spring.

The lesions of cerebral syphilis are many and complex. More or less widespread gummatous meningitis and more or less widespread arterial changes may occur together. Hence results an almost infinite diversity of clinical symptoms.

Cerebral Arteritis.—This leads usually to hemiplegia, to aphasia, to nuclear paralyses of the various nerves, and to mental obfuscation, drowsiness, loss of memory, or epileptiform attacks, finally to insanity.

Basilar Meningitis.—There is usually involvement of one or more of the cranial nerves. There may be headache, vertigo, coma.

Meningitis of the Convexity of the Brain.—Headache, Jacksonian epilepsy, and localized cortical paralyses indicate the site of the lesion. Melancholia and mania are often associated with diffuse lesions of the cortical meninges.

Clinical Types.—Despite the utter irregularity of the symptoms of syphilis of the nervous system, there are certain recognizable types to which a case, for a time, at least, usually adheres.

We may distinguish:

Syphilitic paralysis.	Syphilitic epilepsy.
Ocular paralyses.	Syphilitic insanity.
Hemiplegia and apoplexy.	Syphilis of the spinal cord.
Aphasia.	Parasyphilids.
Deafness.	Tabes.
Facial paralysis.	Paresis.
Other forms of paralysis.	Erb's spastic spinal syphilis.

Syphilitic neuritis.

The existence of cerebro-spinal lymphocytosis is presumptive evidence in favor of paresis, tabes, or some syphilitic lesion, as against hysteria, neurasthenia, and alcoholism.

Prognosis.—If taken in time, syphilis of the nervous system, however grave, however fulminating, may often be controlled and actually cured, so that no trace of it remains. The wildest mania, the deepest coma, the most complete paralysis may yield like magic to prompt and efficient treatment. Medicine can boast no miracle greater than the effect of mercury and iodids upon syphilis of the nervous system.

But such wonders cannot always be accomplished even by prompt and efficient treatment. If the lesion is a diffuse syphilitic arteritis the impairment to circulation (and to function) is in large part permanent when the patient first consults his physician. And in any case, if treatment is delayed until the nerves have degenerated and muscles atrophied, it is vain to ask of any treatment the real miracle that would be required to restore the patient to perfect health.

Treatment.—*At the onset* of the attack the treatment should be *intensive* and *specific*. Mercury is to be given by intramuscular injection and at a maximum dose. Iodid is begun at 10 drops (minims) three or four times a day, and run up to the point of conquering the lesion or gravely poisoning the patient.

Then an intermission; then a milder course.

SYPHILIS OF THE EYE

Iritis.—It occurs usually between the fourth and the twelfth month of the disease. Half the cases of iritis seen by the ophthalmologist are said to be syphilitic.

Diagnosis.—The physician must learn whether there is iritis, whether the iritis is syphilitic, and whether the syphilitic iritis stands alone or is but a complication of other and graver lesions.

The *diagnosis of iritis* need not be discussed here. It is almost invariably established by the presence of other syphilitic lesions and a history of recent "early syphilis." The iritis standing alone is very likely to be dubbed rheumatic.

Is the iritis but one of a number of ocular lesions? This question always merits an accurate answer; for, while no lesion is more benign than the mild iritis of early syphilis, no lesion is more fatally misleading than that same iritis when it conceals the onset of chorio-retinitis.

Hence every syphilitic iritis demands a thorough ophthalmoscopic examination at the outset.

Treatment.—Mercury; atropin for dilatation.

Chorio-retinitis and Retinitis.—Syphilis is the most frequent cause of chorio-retinitis, one of the rare causes of retinitis. Yet, though syphilitic chorio-retinitis is far less rare than syphilitic retinitis, it is not, for all that, a frequent lesion. It is said by some authors to be most often due to hereditary syphilis, while others attribute it usually

to the acquired form of the disease. It may be accompanied by iritis. It is usually unilateral.

Optic Neuritis.—The optic nerve is said to contribute 25 per cent of ocular syphilis. It is one of the common nerve lesions.

Interstitial Keratitis.—This is common in hereditary syphilis, extremely rare in acquired syphilis.

SYPHILIS OF BONE

Bone syphilis and brain syphilis resemble each other in this important particular: either may manifest itself first by pain, worse at night (osteocopic pains, headache), at the time of the first general out-

Fig. 145.—Saber Tibia of Hereditary Syphilis. Diffuse osteosclerosis of shaft of tibia projecting outward and also encroaching upon the medullary canal. (Case of Dr. Jaeger. Skiagraph by Dr. Cole.)

break of symptoms, and later the disease may follow one of three courses, viz.:

1. The pain having been relieved by time or treatment, no further bone (or brain) lesions may appear, or

2. The pain may be followed (with or without an interval of remission) by grave bone (or brain) lesions, or

3. The grave lesions may attack a bone (or brain) in which no pain was felt at the onset of secondary symptoms.

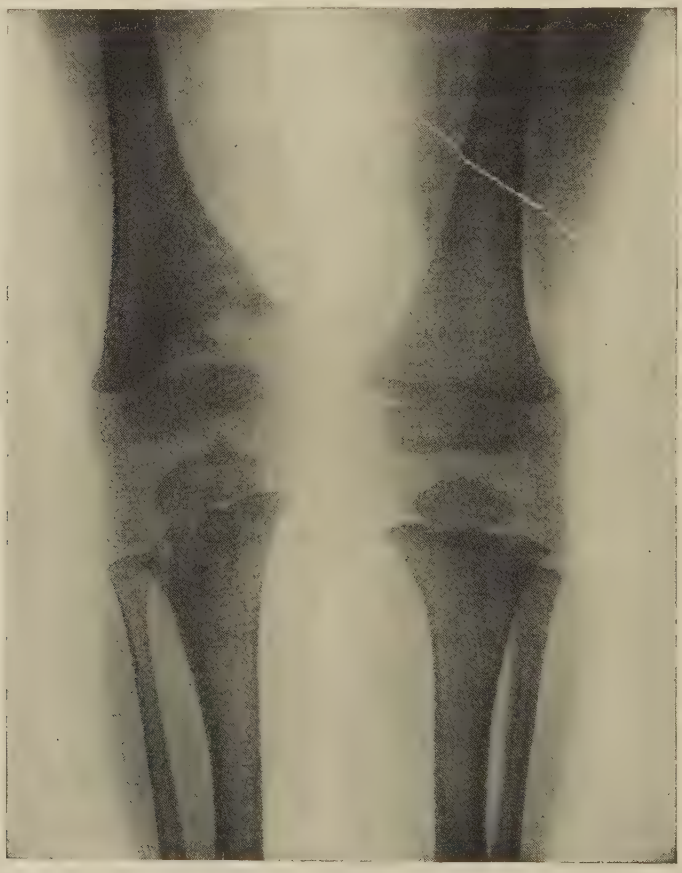

FIG. 146.—GUMMA OF INNER CONDYLE OF FEMUR AND OUTER CONDYLE OF TIBIA (HEREDITARY SYPHILIS): ARTHRITIS. (Compare normal joint.) (Case of Dr. Jaeger. Skiagraph by Dr. Cole.)

Pathology.—There may be osteoperiostitis, gummatous periostitis, or osteomyelitis.

Syphilitic osteoperiostitis is an exudative thickening of the periosteum, which results in productive osteitis and the formation of bony

exostosis unless promptly checked by treatment. The tibia is the bone most often involved.

Symptoms.—*Osteoperiostitis.*—The lesion, as a rule, develops very slowly. When once established, this shows itself as a thickening of the bone. It is usually situated near the extremity of a long bone (tibia, clavicle, ulna), and is diffuse, irregular, insensitive, and without subjective symptoms. Such a deformity simulates nothing else than an exuberant callus, following fracture, from which it may be readily distinguished by the history. The patient usually attributes the pain at the onset to some imaginary injury.

Gumma.—This lesion usually follows an acute course in marked contrast to the chronicity of productive osteoperiostitis. The onset is usually sharp, exceptionally subacute, with little pain and tenderness.

The *swelling,* which may be obscured by the deep situation of the bone (spine, femur), is at first a flattened, hard, circumscribed, tender swelling attached to the bone. As it grows, it becomes softer; the tissues over it first adhere, then become edematous, and finally involved in the gumma. In its subcutaneous situations (tibia, cranial bones) periosteal gumma passes through precisely the same clinical phases as does subcutaneous gumma (p. 791), except that it is from the beginning adherent to and in some measure incorporated in the bone.

Diagnosis.—In doubtful cases by X-ray.

SYPHILIS OF THE ARTICULATIONS

Syphilis simulates every joint disease from rheumatism to tuberculosis. Its lesions may be classified under the following types:

Arthralgia.
Hydrarthrosis.
Pseudo-rheumatism (extremely rare).
Tertiary arthritis and osteo-arthritis (gummatous).
Deforming arthritis.

Syphilitic Arthralgia.—The special characteristics of syphilitic arthralgia are:

1. There is no discoverable lesion sufficient to account for the pain.
2. Nocturnal exacerbation and relief by exercise.
3. Frequent in larger joints (shoulder, knee, elbow), rare in smaller ones; if polyarticular, one joint is usually much more painful than any other.

SYPHILIS OF THE MUSCLES

Apart from the muscle pains that may occur in early syphilis, syphilis of muscles is extremely rare. I have record of only two

cases, one of torticollis (sterno-mastoid spasm), one of bicipital contracture.

The lesions described are:

Contracture.

Interstitial myositis.

Gummatous myositis.

Myositis ossificans.

SYPHILIS OF TENDONS AND APONEUROSES

Tendons and aponeuroses are scarcely ever involved except by extension of a syphiloma from the surrounding parts. The occipito-frontal aponeurosis is said sometimes to be inflamed in early syphilis. I have record of one case of gumma of the teno-Achillis in a patient with many other tertiary lesions.

SYPHILIS OF BURSÆ

Acute bursitis or chronic bursitis with effusion may complicate arthritis. It is extremely rare.

Gummatous bursitis is far more common. It occurs almost always in the prepatellar bursa.

SYPHILIS OF TRACHEA, BRONCHI, AND LUNGS

Syphilis of the trachea and bronchi is associated clinically, on the one hand, with laryngeal syphilis, on the other with lung syphilis; but bronchial or peribronchial syphilitic lesions are entirely distinct from those beginning in the lung tissue.

But all of these lesions are extremely rare.

These tertiary lesions are almost always diffuse infiltrations in and about the trachea with surface ulceration irregular in extent and depth.

Syphilitic Pneumonia.—The interstitial pneumonia caused by syphilis is seen as an uncomplicated process almost exclusively in cases of hereditary syphilis. This is the *white pneumonia of the new-born.*

Cicatricial Lesions.—Syphilitic sclerosis of the lung is the common pulmonary lesion of acquired syphilis. It is usually irregular in distribution, and is believed to be more common in the lower than in the upper lobe, in the right than in the left lung.

Bronchiectasis.—Associated with the interstitial syphilitic changes in the adult lung, just described, one almost always finds bronchial dilatation of various shapes and sizes. In many instances the bronchiectasis is so marked as to be the chief lesion and produces cavities of considerable size, the presence of which can be determined during life.

Hereditary Pulmonary Syphilis.—Usually there are no symptoms. The patient is either still-born or dies within a few hours, and a white pneumonia is discovered among other visceral lesions after death.

In the Adult.—The following types are recognized:

1. The Silent Type.
2. The Broncho-pneumonic Type.
3. The Tracheal Type.
4. The Pseudo-tubercular Type.

The diagnosis is suggested by associated lesions in the other viscera.

SYPHILIS OF THE LIVER

There is a preëruptive jaundice due to *secondary liver syphilis.* Exceptionally, this jaundice occurs or relapses at a later period (within the first eighteen months).

But the term "liver syphilis" is broadly applied, not to this transient secondary lesion, but to the tertiary, the sclero-gummatous lesions, which are the commonest and most obvious visceral manifestations of syphilis.

Occurrence.—Tertiary syphilis of the liver occurs in the later years of the disease. It is often not diagnosed during life; hence one cannot keep an accurate clinical record of its frequency.

Alcohol, hardship, and neglect are obvious etiological factors.

Pathology.—The pathological changes wrought by syphilis upon the liver are almost precisely the same as those of the lung, but uncomplicated by secondary infection.

The liver is usually large and deformed. It may or may not be adherent to the surrounding organs; but the *capsule* almost always shows more or less irregular whitish thickening. This thickening may be due to a diffuse productive perihepatitis or to the thick scars left by healed gummata.

The irregular shape of the liver is due to *bands of dense sclerotic tissue* traversing it irregularly, crisscrossing at various points.

The gummata are found either as hard, yellowish nodules or as cheesy masses at the intersection of several bands of sclerosis or beneath (and involving) the capsule. These gummata are rarely smaller than a pea, and may attain an enormous size, projecting noticeably from the surface of the enlarged viscus. They are usually quite numerous.

Symptoms.—The symptoms of hepatic syphilis—when it excites symptoms—are usually comparable to those of (nonsyphilitic) cirrhosis or of neoplasm. In many instances, however, there are no local signs of disease, in which case there may or may not be a marked and progressive

cachexia. Finally, there remains a small class of cases in which fever is the predominant symptom.

We may, therefore, classify the symptoms of hepatic syphilis according to the following types, arranged in what is probably their order of frequency; but recognizing that, whether in the liver or elsewhere, syphilis is bound by no absolute law of type:

1. Neoplastic type.
2. Cirrhotic type.
3. Cachectic type.
4. Febrile type.
5. Silent type.

SYPHILIS OF THE OTHER VISCERA

Though syphilis may strike any of the other viscera, such lesions are too rare to deserve mention here.

CHAPTER LXXVIII

HEREDITARY SYPHILIS

Fournier reports that *paternal syphilitic heredity* causes 67 per cent of the children to be syphilitic and 28 per cent to die; *maternal heredity* produces 84 per cent syphilitic and 68 per cent deaths, while *mixed heredity* (both parents syphilitic) produces 92 per cent syphilitic children, with 68.5 deaths.

Le Pileur reports a hospital experience of 567 pregnancies of syphilitic women, with 174 abortions.

Thus the most striking effect of hereditary syphilis is its polymortality among infected children, while the dangers of infection to the child are thus stated by Fournier:

1. The danger of syphilitic inheritance varies greatly with the age of the disease in the parent, but shows a maximum—and that a marked one—corresponding to the first three years of infection.
2. The maximum of this maximum corresponds approximately to the first year.
3. Beyond the first three years of the disease there is a decreasing danger, but infinitely less marked.
4. Syphilitic heredity has occurred in the sixth, the eighth, the tenth, the twelfth years, even the fifteenth, and perhaps the seventeenth, the eighteenth, and the twentieth, which appears to be the extreme limit.

The important features of hereditary syphilis may be subdivided as follows (Hochsinger):

1. Fetal syphilis.
2. Infantile syphilis (first three to six months).
3. Relapses in infancy (until the fifth year).
4. Late hereditary syphilis.

The importance of these stages decreases throughout the series. Thus fetal syphilis is fatal to about one half the infected children. Infantile syphilis kills fully half as many more in the first three months of extra-uterine life. The later relapses in infancy are less frequent, less severe, and rarely fatal, while the so-called "late" or "delayed" hereditary syphilis, which occurs after the fifth or sixth year, differs in

no respect from tertiary syphilis in the adult. But the adult who has suffered hereditary syphilis in infancy bears upon his body certain evidences of the storm that has passed. These form a fifth division:

5. Stigmata of hereditary syphilis.

FETAL SYPHILIS

Pathology.—The pathology of fetal syphilis differs from the same process in the adult chiefly in its hyperacuteness. In the adult the disease localizes itself here and there in small areas and shows a special affinity to the skin and mucous membranes, and later to the nervous system, the underlying process being always specific arterial disease. But in the fetus the chief localizations are in the viscera, and secondly in the bones; the skin is immune until just before or just after birth. Moreover, the hyperacuteness of the process is shown in its diffusion throughout an organ, contrasting strikingly with the circumscribed visceral involvement in the adult.

The viscera most frequently and most markedly affected are, in order of importance, the lungs, the liver, the kidney, and the spleen.

The type of congenital syphilis is a diffuse cell proliferation arising from the perivascular connective tissue of the smallest vessels, so that the solitary syphiloma is very rare in the fetus and the infant.

The infiltration is exclusively a diffuse one arising from the smallest vessels in the organ, with a special tendency to later contraction and obliteration of these vessels. The perivascular proliferation begins in a sleevelike way in the adventitia and extends outward into the connective tissue, less often into the inner wall of the artery, thus obliterating it. In all the diseased organs one finds here and there dense cell accumulations visible to the naked eye and spoken of as "miliary syphilomata" or "gummata."

In the affected organs we find checked development of the parenchyma, abnormal development of the Malpighian bodies, persistent epithelial rests and canals, cystic development of the cortex of the kidney, etc. *Thus the hyperplasia of the connective tissue goes hand in hand with a hyperplasia of the parenchyma.* These changes can often not be made out macroscopically, and we note only an increase in volume and density of the liver and spleen (Hochsinger).

The placenta usually shows changes similar to those in the fetal viscera. Both the maternal and fetal portions of the placenta show the diffuse perivascular infiltration, so that the placenta is more voluminous and heavier than normal (it may reach one fourth or one third the weight of the child); the cord is also hard and considerably enlarged.

Symptoms.—The fetus affected with syphilitic visceral lesions may come to one of three ends, as follows:

1. It may be aborted or still-born.
2. It may be born manifestly syphilitic.
3. It may be born apparently healthy.

1. *The death of the fetus in utero* is often caused by hydramnia, depending upon syphilitic phlebitis of the cord; or by inanition from overwhelming visceral disease. Abortion usually occurs between the fourth and the seventh month, and the fetus thus aborted is usually dead and macerated. Monstrosities are said to be relatively frequent because of the interference with placental circulation.

2. *The typical syphilitic infant* presents a picture of pseudo-senility —thin, feeble, marantic, with a dull, *café au lait* color, a wrinkled, loose skin, upon which, even at birth, there may be an eruption; with the snuffles, with a hoarse cry, with sunken and inflamed eyes, and perhaps with pseudo-paralysis or some lesion of the nervous system, the unfortunate infant forms a horrible picture of the ravages of hereditary syphilis.

Among the syphilitic infants born alive relatively few present so marked a picture of the disease. Not only may the infant be born with no actual syphilitic lesions apparent, but he may be in good condition. The skin is likely to be lacking in pinkness and fullness and the infant rather under weight. Thus Tarnier, among 52 syphilitic children, found 14 of normal weight (above 3,250 gm.) and 38 below it (Hochsinger).

3. *But the child with syphilitic lesions of the viscera may be born seemingly in good health.* Its weight may be ample, its syphilitic symptoms nil, its viscera and bones and skin apparently normal. Yet lesions of the disease develop shortly after birth, and, if these prove fatal, autopsy reveals extensive visceral involvement.

The direct evidence of the syphilitic visceral lesions is the enlargement of spleen and liver or of the pseudo-paralysis from osteochondritis.

INFANTILE SYPHILIS

Although the lesions presented by the infant with hereditary syphilis are due to precisely the same protozoal cause as those in the adult, they are markedly dissimilar. Thus we have seen that, in the fetus, the viscera are the chief points of attack. In the infant the disease first strikes the mucous membrane of the nose, producing snuffles, and then shows itself by lesions upon the skin; but these skin lesions are not the same in character as those of early syphilis in the adult, nor are they by any means constant.

Intermingled with these symptoms, or succeeding them, there may

be evidences of bone or visceral disease, or the little patient may show his malady simply by his thinness, his slow gain in weight, and his restlessness.

Taking up the early symptoms in order of clinical importance, we shall discuss:

Inflammation of the nose.
Inflammation of the skin.
Inflammation of the bones, joints, and muscles.
Inflammation of the viscera.
Mixed "infection" (pyogenic or tubercular).
Syphilitic dystrophies.

INFLAMMATION OF THE NOSE

"Snuffles" is the earliest and most constant symptom of hereditary syphilis, and one of the least characteristic.[1] The symptom is not quite that of snuffles in an older child, for at first there is little or no running from the nose, but only an obstruction to nasal respiration which makes the child breathe in a characteristic snuffly way and gravely interferes with nursing.

Fig. 147.—Syphilitic Nose.

Hochsinger has tabulated 65 cases, of which 38 began at birth, 15 in the first month, and 12 later than the first month.

The inflammation begins as hypertrophy of the nasal mucous membrane, at first a dry congestion beginning in the lower part of the nose, which soon goes on to ulceration and causes a profuse mucous discharge, often tinged with blood; epistaxis is most exceptional. The discharge is acrid, and excoriates the upper lip. Perforation of the septum is rare in infancy but the development of the nasal bones is impaired or arrested and the bridge of the nose left sunken in a characteristic manner (later relapses of hereditary syphilis of the nose commonly cause perforation). Hence result the various nasal deformities so suggestive of syphilis (Fig. 147).

The first clinical evidence of this nasal disease is *restlessness,* due to the fact that the little patient's sleep is constantly interfered with by the difficulty of breathing through its stopped-up nose. The *snuffly breathing* soon follows, and the infant, being unable to breathe through

[1] For it may be due to many causes.

its nose, may be *almost totally unable to nurse;* its attempts at suckling and swallowing being frustrated by the rapidly recurring need of breathing, so that the process becomes a disheartening series of gasps, chokings, and regurgitations, which result in the ingestion of little or no nourishment. Thus this relatively insignificant lesion may be the chief cause of a grave impairment of nutrition.

INFLAMMATION OF THE SKIN

The striking characteristics of the first skin lesions of hereditary syphilis are:

1. Polymorphism.
2. Regional distribution.
3. Confluence.

Most of the lesions are papular or maculo-papular, while an occasional macule may be seen, though no general macular eruption is encountered.

The papular eruption of hereditary syphilis is quite comparable to that of acquired syphilis (p. 782), except that it is commonly intermingled with lesions of a macular character, and is itself often confluent.

Polymorphism.—On account of the tenderness of the skin this papulomacular eruption very readily takes on secondary changes. In dry regions the lesions tend to become squamous, or, if the eruption is severe, bullous or pustular; while in moist regions the lesions are often confluent, erosive, and ulcerated.

Regional Distribution.—The eruption usually appears about the genitals, the buttocks, the flexor surfaces of the thighs, upon the palms and soles, and upon the lips and chin. The scalp, arms, and legs are somewhat less frequently affected, while the upper part of the trunk above the line of the diaper is relatively immune, doubtless because it is the dryest and thickest skin upon the infant's body.

Confluence.—The marked tendency to confluence shown by the early skin lesions of hereditary syphilis is due to the tenderness of the skin and the difficulty in keeping it clean; hence the confluent lesions are usually seen under the diaper, in various moist creases of the body, and about the mouth.

It is convenient clinically to distinguish five types of lesions:

1. Pemphigus.
2. Circumscribed maculo-papular syphilid.
3. Diffuse maculo-papular syphilid.
4. Lesions of special regions.
5. Tubercular or gummatous syphilid.

Pemphigus

The earliest, one of the rarest, and the most ominous skin lesion of hereditary syphilis is pemphigus, or the bullous syphilid. It appears before birth or in the first week of extra-uterine life, less often in the two or three weeks following. Its typical situation is upon the palms and soles, whence it may spread over the rest of the body.

The eruption consists of large, copper-colored papules, upon which are set flaccid blebs containing serum and pus or blood. As these rupture they leave an eroded surface; or, if the ulceration is deep, greenish scabs take the place of the ruptured bullæ. When this eruption occurs before the second week of extra-uterine life it is an accepted sign that the child will die.

Diagnosis.—It may be readily distinguished from the pemphigus neonatorum, which never occurs before the second week, and usually much later, is often epidemic, occurs upon otherwise healthy children, and only most exceptionally appears upon the palms and soles.

Circumscribed Maculo-papular Syphilid

This is the common and typical eruption of early hereditary syphilis.

In moist creases of the infant's skin the papules become eroded, and may even become condylomatous; while, wherever there is much irritation (especially beneath the diaper and about the mouth), they tend to run together and to ulcerate. Pustulation is, in the child as in the adult, an evil omen.

Diffuse Maculo-papular Syphilid

The diffuse maculo-papular syphilid, not so common as the circumscribed form, but often associated with it, never begins in intra-uterine life, usually appears within the first three months after birth, and may relapse during the first year. It occurs most frequently beneath the diaper, on the palms and soles, and on the face.

Lesions of Special Regions

Erosions of the Lips.—Eroded mucous papules are very common upon the vermilion border of the lips, and are promptly fissured and transformed into deep-red, oozing cracks, surrounded or covered by a little crust. They are usually multiple, and are commonest at the angle of the mouth. They are extremely painful, and interfere gravely with suckling. As they heal they leave marked radiating linear scars

upon the lips, which in later years form one of the most striking and reliable stigmata of hereditary syphilis.

Ano-genital Lesions.—These are usually associated with dry or scaly papules elsewhere in the body, and are themselves confluent, erosive, or ulcerated, rarely condylomatous, and still more rarely pustular. But in the relapses of early childhood condylomata are very common.

Onychia and Paronychia.—The typical nail of the syphilitic infant is raised high in the center and depressed laterally, as though it had been pinched by a forceps (Holt). It resembles a claw rather than a nail. The condition usually affects all the nails.

Such nails are often undermined by paronychia, so that they are readily detached.

Lesions of the Scalp.—The moth-eaten poll is quite uncommon in infancy, and more extensive baldness (which has the same characteristics as in the adult) very rare.

The papular eruption upon the scalp, instead of forming small, disseminated, crusted lesions, as in the adult, may produce an extensive incrustation closely simulating eczema; but the syphilitic lesion is distinguished by the fact that removal of the scabs leaves an intact, though infiltrated, area beneath it, while removal of an eczematous crust leaves the Malpighian rete exposed.

Tubercular and Gummatous Syphilid

It is not always possible to distinguish between a furuncle and a syphilitic tubercle or gumma; indeed, these lesions are classed as "furuncular syphilids" by Taylor, while their syphilitic nature is entirely denied by Jacquet; they are, however, accepted by most authorities, and Carpenter states that among 364 syphilitic eruptions seen by him during the first year of life there were 70 cutaneous gummata, 34 of which were associated with other lesions of the skin.

The lesions are those of syphilitic tubercle and subcutaneous gumma; but they have an especial tendency to become pustular, and so remain for a considerable time before ulcerating. They come out in successive crops, and disappear under mercurial treatment.

LESIONS OF THE MUCOUS MEMBRANE

Excepting the nose, the lips, and the anus, lesions of the mucous membrane are extremely rare. The ulcers that occur in the mouth are alleged by many authors to be aphthous, not truly syphilitic.

Aphonia is frequent, however, and is apparently due to infiltrative and ulcerative laryngeal lesions similar to those seen in the adult. The

familiar "hoarse cry" of the syphilitic infant is quite as suggestive and far more common than the hoarse voice of the syphilitic adult.

The intestine may be inflamed, and may show *postmortem* a diffuse thickening of the mucous membrane with ulceration.

INFLAMMATION OF THE BONES

While any of the lesions of bone that occur in the adult may also occur in hereditary syphilis, the two striking and distinctive characteristics of bone syphilis in the infant are osteochondritis and periostitis.

The former begins before birth, the latter shortly after birth; a difference explained by Hochsinger as due to the fact that syphilis attacks the most actively functionating region, which is the epiphyseal junction in intra-uterine life and the periosteum thereafter. Both types are in their milder manifestations extremely common.

Osteochondritis.—Mild syphilitic osteochondritis, causing slight distortion and enlargement of the bone at the epiphyseal line, is very common. Its lesions can be accurately studied only by the X-ray.

The knee and the elbow are most commonly and most markedly affected and the lesion consists in a syphilitic infiltration of the diaphysis at its junction with the epiphysis, which results in a thickening of the bone at this point and a marked irregularity at this line of junction. Very rarely this lesion progresses so far that the granulomatous tissue, disintegrating the epiphyseal cartilage, produces an epiphyseolysis. This rare lesion, appropriately called "syphilitic pseudo-paralysis of the new-born," usually affects the elbow and is congenital; it may be polyarticular.

Epiphyseolysis occurs only when there is marked visceral disease, and is an evil omen.

Periostitis.—The periosteal lesions of early syphilis are usually most marked upon the skull, though similar lesions may affect any bone.

The lesions of syphilis in the skull are, in order of frequency—infiltration and softening between the tables and in the sutures; diffuse periostitis of the frontal or parietal bosses, causing an enlargement which, if frontal, produces the so-called "Olympian" brow; if lateral, a considerable widening of the transverse diameter of the skull (natiform skull). Less frequent is the rarefying ostitis with tendency to gummatous degeneration. Finally, the skull may be affected secondarily by hydrocephalus.

American authorities consider it unsafe to accept cranial deformities as evidence of hereditary syphilis unless supported by other typical signs. Parrott's nodes and craniotabes, though sometimes spoken of as syphilitic, are actually of rachitic origin.

Dactylitis.—Dactylitis is far more common in hereditary than in acquired syphilis.

INFLAMMATION OF THE VISCERA AND OTHER ORGANS

Lymph Nodes. — Lymphadenitis is not typical of hereditary syphilis. Marked epitrochlear adenitis is of some diagnostic importance. The presence of other enlarged nodes is, as a rule, directly attributable to adjacent lesions.

Testicle.—Syphilitic sclerosis of the testicle is extremely common in still-born children. It is rare in those that survive.

Inasmuch as the size of the testicle in infancy varies between wide limits, while syphilis of the organ often does not greatly alter its size, the clinical manifestation of the lesion is usually an *increase in hardness,* which may be masked by hydrocele. Testis and epididymis may be involved separately or together. The lesion usually leads to atrophy of the testicle, and great stress is laid by certain authors upon the existence of this atrophy in adult years as an evidence of hereditary syphilis.

Diagnosis. — Inasmuch as tuberculosis of the testicle may occur shortly after birth (Dreschfield has recorded a congenital case), and produce lesions macroscopically similar to those of syphilis, the diagnosis is not always possible; but of the two diseases syphilis is by far the more common.

Liver and Spleen.—Hereditary syphilis of the liver and spleen are so intimately associated that it seems proper to consider them as one. Syphilitic changes may be found in these organs in many instances *post-mortem,* although no evidence of such disease was apparent during life. The pathological changes have already been described.

Clinically, the manifestation of these lesions consists in an enlargement of the affected organs. This enlargement is noted in 30 per cent to 40 per cent of cases in the first three months of life; and in almost every instance enlargement of the spleen implies enlargement of the liver, and *vice versa.*[1] The enlargement, though usually slight, may be considerable, and, exceptionally, one may identify thickening of the edge and irregularity of the outline of the liver, as in acquired syphilis. Syphilitic jaundice is extremely rare in early infancy. Ascites does not occur until a later age.

Lungs.—The lesions are so commonly fatal that they can scarcely be said to give any clinical manifestations.

[1] Hochsinger found that splenic enlargement accompanied hepatic enlargement in 44 out of 46 cases. He also states that only 3 per cent infants showing enlargement of the spleen were not syphilitic. Carpenter states that when the spleen is enlarged the liver is also enlarged in four fifths of the cases.

Nervous System.—*Restlessness and sleeplessness* are striking symptoms of early hereditary syphilis, and have been referred to meningeal irritation, but are more often due to nasal obstruction. Though these early cases may show *postmortem* lesions throughout the nervous system, they show during life no evidence of peripheral neuritis or of syphilis of the cord; while symptoms of syphilitic meningitis other than restlessness, sleeplessness, and convulsions are extremely rare. The only exception is *hydrocephalus*. This, whether acute or chronic, internal or external, is often syphilitic, and develops with the first outbreak of symptoms (in the first or second month). So common is this association of hydrocephalus and syphilis, and so hopeless is the former condition when not syphilitic, that it is most excellent practice to treat every infant with hydrocephalus as though it were syphilitic.

Eye.—Lesions of the eye are extremely rare at this early date.

Ear.—Extension of the nasal catarrh to the middle ear, resulting in acute otitis media, is not uncommon.

MIXED INFECTION

As a frequent and grave complication of early hereditary syphilis it shows itself chiefly in four types:

1. Mixed infection of the skin.
2. Mixed infection of the respiratory tract.
3. Mixed infection of septic type.
4. Tuberculosis and rachitis.

Skin.—Mixed infection of the skin shows itself in the frequency of pustular and ulcerating lesions, while pseudo-furunculosis is due in most instances to pyogenic bacteria.

Respiratory Tract.—The discharges of syphilitic coryza swarm with spirochetæ and with all manner of bacteria. Hence the inflammation may spread to the ear, causing otitis media, or to the lung, causing broncho-pneumonia. This latter complication accounts for many deaths.

Sepsis.—The petechiæ and other hemorrhagic skin lesions that occur in certain malignant cases of early hereditary syphilis are, doubtless, evidences of acute septicemia.

Tuberculosis and Rachitis.—The relation between rachitis and syphilis has long since been determined. Parrott believed and taught that every rachitic child was syphilitic; but subsequent investigation has clearly shown that this is not the case, that syphilis is only one among many potential, debilitating causes of rickets.

The same is true of tuberculosis. Sergent[1] has recently collected

[1] "Syphilis et tuberculose," Paris, 1907.

much evidence in the matter, and, with a wealth of authoritative quotations, enforces his conclusions that "la syphilisation du père a préparé le terrain pour la tuberculisation du fils"—syphilis in the father prepares the soil for tuberculosis in the son.

This aphoristic statement expresses the actual condition not quite accurately. It is necessary to distinguish as follows:

1. Syphilis in the father, if severe or if allied with other debilitating influences, such as drink, deprivation, or debauch, prepares the father's own soil for tuberculosis.

2. Syphilis transmitted from parent to child—hereditary syphilis—exercises the same predisposing influence magnified by the difficulty of eradicating the disease from the vulnerable tissues of the new-born.

3. But the nonsyphilitic child of a syphilitic parent is not predisposed to tuberculosis, unless by such privation or neglect as would so predispose it in any event.

Although tuberculosis and rachitis are frequently attendant upon syphilis a little later in life, they scarcely figure in the first few months.

SYPHILITIC DYSTROPHIES

The interference with nutrition due to hereditary syphilis shows itself in two ways: First, and most frequently, by killing the child within a few days of its birth; secondly, by impairing its nutrition, but not killing it.

The first evidence of impaired nutrition may be the puny, decrepit state of the child at birth; or it may be born apparently healthy, and promptly lose weight and strength in spite of a good digestion and an abundant supply of mother's milk. Such infants, though they may survive for a time, are carried off either by the cachexia of the disease itself or by such complications as convulsions, diarrhea, or broncho-pneumonia during the first year of their lives.

From these various causes something like nine out of ten bottle-fed or hospital babies fail to survive, though in private practice hygiene, human milk, and intelligent medical care cut down the mortality considerably.

But beyond this obviously syphilitic toxemia there is a set of vague conditions, such as go to produce congenital deformities—e. g., club-foot, harelip, etc.—or to arrest development, causing the child to attain puberty very late, to have its sex characteristics but slightly developed, and to remain childish both in mind and body. Idiocy and epilepsy are said to be exceptionally frequent in otherwise apparently healthy children of syphilitic parents.

In how much these conditions are due to a real syphilis of the child and in how much to an inherited tendency from the parent (similar to

that of alcoholism, for instance) it is difficult to say; but it is perhaps safer to assume that in most instances the child is actually syphilitic, and does harbor or has harbored the spirocheta.

LATE HEREDITARY SYPHILIS

From the sixth to the eighth year, and again at about the time of puberty, hereditary syphilis may relapse; relapses excepting at these times are infrequent.

The arbitrary limit of twenty-six years set by Fournier for the duration of hereditary syphilis is, in general, the extreme limit; indeed, lesions after puberty are extremely rare.

The active syphilitic lesions of late hereditary syphilis are, with but very few exceptions, quite the same as those that occur in late acquired syphilis. They are, in other words, the tertiary lesions of the disease occasionally intermingled, as in acquired syphilis, with certain late secondaries, especially those of the palms, the soles, and the tongue. Certain classes of lesions are, however, somewhat more common in late hereditary than in late acquired syphilis. Such are the various lesions of the eye, deafness from internal ear disease, perforation of the septum and palate, and diffuse periostitis of the long bones. The joints are relatively often affected, and the danger of mistaking a pseudo-tubercular syphilitic knee in the young for the tubercular "white swelling" must be borne in mind.

The chief exceptions in which late hereditary syphilis differs from late acquired syphilis are diffuse periostitis and parenchymatous keratitis. Besides these two lesions there are, however, many stigmata of early hereditary lesions, which will be taken up in the following section.

STIGMATA OF HEREDITARY SYPHILIS

The stigmata of hereditary syphilis are the scars of syphilitic lesions or the deformities or peculiarities in development left by syphilitic lesions occurring in infancy or in youth. They are more or less pathognomonic of the disease, though few of them (only the radiating fissures of the lips and the typical saber tibia) are absolutely so. Yet many of them are presumptive evidence of the greatest importance.

Only the important stigmata need be described.

The chief stigmata of hereditary syphilis may be classed as follows:

1. Hutchinson's triad, consisting of dental, ocular, and auditory stigmata.
2. Bone stigmata.
3. Skin stigmata.
4. Visceral stigmata.
5. Constitutional stigmata.

Of these, the first three are of prime importance, the two last are rarer and less characteristic.

The chief bone stigmata are found in the skull (frontal or lateral bosses, asymmetry and irregular development, hydrocephalus), in the nose (sunken bridge), and in the long bones (diffuse periostitis, saber tibia, and such scars of epiphyseitis as epiphyseal enlargements, and arrested or excessive growth of the bone). The skin stigmata do not differ from those of acquired syphilis, excepting the important lip fissures. The only notable visceral stigmata are atrophy of the testicle and parenchymatous keratitis. The constitutional stigmata consist of a gray, bloodless skin and a slowness of physical and intellectual development that may amount to "infantilism" or idiocy.

Diffuse Periostitis.—The periosteal changes of late hereditary syphilis are the same as those of acquired syphilis excepting in their distribution. The hereditary lesions are, however, often much more diffuse than the acquired ones, sometimes extending over the whole length of a long bone. This diffuse process is most common in the tibia, to which it imparts a peculiar and pathognomonic form. The shaft of the bone is thickened in all its diameters, but especially antero-posteriorly; so that, at first glance, the bone appears to be bowed forward; but palpation reveals that this bowing is simply a thickening around it of new bone without any deviation in its axis (Fig. 145).

Hutchinson's Triad

Most important among the stigmata of hereditary syphilis are those lesions grouped as a triad by Jonathan Hutchinson, Sr., from whom they very appropriately derive their title.

"Hutchinson's triad" is commonly taken to mean the association of—

1. Notched and pegged upper, central, permanent incisors.
2. Interstitial keratitis or the scar thereof, and
3. Nerve deafness.

But though these three are the most striking of the lesions in question, it is preferable to employ the term in a looser sense to cover all.

1. Dental stigmata,
2. Ocular stigmata, and
3. Aural stigmata.

Dental Stigmata.—The dental stigmata of hereditary syphilis are due to arrested development of the teeth in the process of formation. Permanent incisors and the sixth-year molars are the teeth most often affected because they are in process of formation during the first three months of extra-uterine life—i. e., at the very time when hereditary syphilis shows its greatest virulence.

Hereditary syphilis may, however, impart to the teeth almost any malformation in size, position, and shape. Fournier, who has made a special study of this matter, describes some ten varieties of syphilitic dental deformities.

Hutchinson's Teeth.—This deformity, though not peculiar to any tooth, is usually confined to the permanent, upper, median incisors. It is not absolutely pathognomonic of syphilis.

Typical Hutchinson's incisors are abnormally small, pegged (i. e., tapering inward from above downward), and show a peculiar erosion of the free border. This erosion forms an absolutely regular crescentic

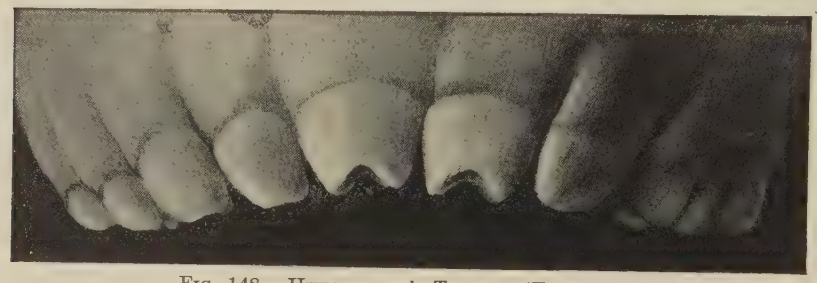

FIG. 148.—HUTCHINSON'S TEETH. (From a cast.)

bevel of the anterior surface of the free border of the tooth. When the tooth erupts, its free border is quite rough, but this roughness rapidly wears away, leaving a typical Hutchinson's tooth, which retains its characteristics for some fifteen or twenty years. But by the time the patient reaches the age of twenty or twenty-five the bevel edge is all worn off. Hutchinson's teeth are almost always symmetrically bilateral, and affect the permanent, upper, central incisors, which are often somewhat displaced, usually converging toward each other.

Fournier's Teeth.—Fournier has described a less characteristic deformity of the sixth-year molar, which he says is even more common than Hutchinson's teeth.

The deformity consists in an erosion of the summit of the tooth. About three fourths of the tooth is entirely normal; the terminal fourth "is diminished in all its diameters, irregular, eaten, as though atrophied, and separated from the healthy part by a circular ridge." After five or ten years of use this eroded crown wears away, leaving a short tooth with a smooth top, to which Fournier attaches considerable diagnostic significance.

Parenchymatous Keratitis.—Parenchymatous keratitis, though it may occur in the first months of extra-uterine life or even before birth (Parinaud), and as late as the thirty-sixth year (Huguenin), is common only between the eighth and the fifteenth year (Hutchinson). It is one of the frequent manifestations of hereditary syphilis, occurring

very frequently (59 per cent, according to Huguenin). On the other hand, it is by no means pathognomonic of syphilis. Though Hutchinson places great weight upon it as a diagnostic sign, careful investigation reveals other evidences of syphilis in not much more than one half the cases (36 per cent, according to Alexander; 55 per cent, according to Michel). Hence it is not of itself an absolute proof of the existence of syphilis.

Moreover, interstitial keratitis may occur in acquired syphilis. My father has seen two instances of this.

Auditory Stigmata.—Deafness may result either from lesions of the middle ear or from those of the inner ear or of the nerve. Middle-ear deafness is only indirectly due to syphilis, and is much more often due to other causes.

But internal ear or "nerve" deafness in children or young persons is almost exclusively due to syphilis.

TREATMENT IN INFANCY

The treatment of hereditary syphilis is based upon the same rules as is that of acquired syphilis, with the important difference that our hygienic efforts are confined almost solely to the matter of diet, mother's milk being almost as important as doctor's mercury.

There is this further distinction to be made in the matter of mercurial treatment, that, if the mother is properly treated with mercury during her pregnancy, the hereditary syphilis should be prevented and the child be born at term uninfected.

Fournier would have us treat these apparently uninfected children as though they had syphilis, hoping thus to forestall an unsuspected latent disease. But other authorities do not follow this rule.

The duration of routine treatment in infancy should cover the first two years, just as in adult life. Certain practitioners are in the habit of renewing treatment at the period of second dentition and again at puberty; yet it seems wiser not to employ this routine practice, but simply to warn the parents that, if the child shows any deterioration in its health or local signs of syphilis, at these times, it should be treated. Indeed, a very brief treatment may suffice to quell the disease. But it is the part of wisdom to clinch the advantage gained by a course similar to those employed in the adult and covering the first two years. In infancy, however, two rules apply:

1. Iodid of potassium is useless in the first year.

2. Mercury may be given by mouth or by inunction. Intramuscular injections have found little favor, though the employment of both the soluble and the insoluble salts has been urged.

The usual treatment consists in the application of the officinal ung.

hydrargyri, diluted with two or three parts of vaselin (reducing it to one third or one quarter strength). This is laid on the belly band and renewed with it. No special precautions need be taken to prevent irritation of the skin, and the application may be continued daily throughout the treatment with only such intermissions as may be required by the appearance of diarrhea, dermatitis, or intercurrent disease.

Infants bear mercury very kindly, and do not become salivated.

For internal administration (if inunction proves inefficient or irritating) gray powder is usually employed, mixed with two or three parts of sugar. Beginning with a quarter or half a grain t. i. d., the dose is rapidly increased to a grain t. i. d. For a more rapid effect, Holt employs calomel (gr. $\frac{1}{10}$) q. i. d., until the bowels are touched.

Injections may be employed in about one tenth the adult dose. This dose may be doubled at the time of second dentition, and trebled thereafter.

Local Treatment.—The baby's skin must be kept absolutely clean and dry, diapers frequently changed, and powder freely used. Erosions and condylomata are to be treated, as in the adult, by drying and calomel powder; but it is safer to dilute the calomel with two parts of starch or talcum powder.

The nasal congestion in snuffles may be somewhat reduced by anointing the inside of the nose with ammoniated mercury ointment. Since stomatitis does not occur in infancy, no especial care of the mouth is required; but erosions and fissures upon the lips may be touched once a week with the nitrate-of-silver stick.

It is safer, as a general rule, not to incise the furunculoid lesions, inasmuch as they are discrete and are often cheesy rather than suppurative; but when at the surface or already burst, they should be cleansed daily, or twice a day, with hydrogen peroxid diluted to one half strength.

TREATMENT OF RELAPSES AFTER THE SECOND YEAR

In childhood, and especially at the time of the second dentition, the outbreak of tertiary symptoms may require mixed treatment.

The iodid is then to be administered quite as for adults. It is well borne, and the initial dose may be from 3 to 5 grains t. i. d.

Mercury may be given in from one third to one half the adult dose, but injections should be given at about one fifth strength.

It must not be forgotten that no amount of treatment will reduce an organized deposit of bone caused by diffuse periostitis, and that parenchymatous keratitis seems to run its course quite independently of antisyphilitic treatment, though this is habitually employed.

CHAPTER LXXIX

GENERAL CONSIDERATIONS IN OPERATING ON THE URINARY ORGANS

The major operations upon the urinary organs are often performed upon patients whose kidneys are gravely diseased by suppuration, and whose constitutions are more or less undermined, both by infection and by renal insufficiency. The following considerations are of importance, in the order given:

Accurate diagnosis.
Improvement of the kidney action and reduction of sepsis.
Choice of anesthetic.
Choice of operation.

After the operation, the important special considerations are:

Facilitating the action of the kidneys.
Drainage (retained catheter).

ACCURATE DIAGNOSIS

It is self-evident that the diagnosis, before operation, should be as accurate as possible; and to this end it may be necessary to invoke cystoscopy, urethroscopy, functional kidney tests, and the X-ray, over and above the usual routine study of the history, examination of the patient, and urinalysis. Yet for the emergencies of urinary surgery the surgeon who is not equipped with the skill to catheterize a ureter, or the apparatus to radiograph a kidney, is, generally speaking, quite competent; for the emergency can be studied along general surgical lines and handled along the same lines. But obscure diseases of the kidney or bladder, especially renal tuberculosis, should never be operated upon in a hurry if this can be avoided. Every means should be taken to verify the diagnosis to the most minute degree, in order that no time may be wasted during the operation in uncertain groping which may, by prolonging the anesthetization, cost the patient his life.

IMPROVEMENT OF THE KIDNEY ACTION

The action of the kidneys may be improved in two ways: viz., by drainage and by the administration of urinary antiseptics.

If there is any question of the ability of the kidneys to stand the shock of operation, it is proper to establish preliminary drainage. This can be done with great advantage in cases of prostatic hypertrophy, by systematic catheterization, by the retained catheter, or by preliminary urethrotomy or cystotomy, as suggested in Chapter XXVIII. If there is ureteral obstruction, it may be advantageous to perform preliminary nephrotomy before undertaking nephrectomy, if this is contemplated. Yet the skilled operator can usually remove a kidney with as little shock to the patient as he can drain it. A deliberate preliminary nephrotomy, in preparation for nephrectomy, is employed very rarely excepting when there are large suppurating cavities about the kidney that require drainage, or when the kidney itself is so embedded in ancient scar that its removal is a tedious and difficult operation.

Preliminary antisepsis, on the other hand, should always be undertaken. This consists chiefly in the administration of water and of hexamethylenamin. The water is usually administered by mouth; if this cannot be done, by rectum. It is of importance to promote a free flow of urine, and it is equally important not to overstrain the kidneys. Generally speaking, a tumblerful of water every three hours is about the limit of safety; or by rectum, six ounces of water or a copious colon irrigation once a day. In many instances this preliminary diuresis is unnecessary; but if the kidneys are infected it may be of great service to continue it for several days before operation.

Hexamethylenamin should be administered according to the rules laid down for the treatment of renal infections (p. 343). There seems to be little advantage in giving it in doses higher than 0.5 gm. three times a day, but this dose should always be administered for three days before operation unless emergency forbids. The diet need only be regulated in reference to the renal capacity. If the kidneys are gravely diseased, a light, nonproteid, salt-free diet should be adhered to with special strictness for several days before operation, and rest in bed for these several days is extremely useful, unless the patient's nervous condition will not permit it.

CHOICE OF ANESTHETIC

If spinal anesthesia were entirely safe, it would be ideal for operations upon the urinary organs. Under it operations can be performed with less shock than under any other form of anesthesia; but the occasional accidents that occur under its use have rendered it unpopular with most surgeons in this country. On the Continent of Europe it is frequently employed. Local anesthesia is scarcely applicable in operations upon the kidneys and ureter, though it has frequently been advan-

tageously employed in operations upon the urethra and in establishing preliminary bladder drainage. One of the greatest advantages of Chetwood's galvanic cauterization for the relief of prostatic retention is that it may be performed under local anesthesia.

The choice between chloroform and ether is delicate and difficult to decide. Ether certainly irritates the kidneys more than chloroform.[1] Yet chloroform is so dangerous to the heart that, practically speaking, as large a proportion of deaths may doubtless be attributed to it in operations upon the renal organs as to ether. The rule followed by most surgeons is to employ the anesthetic with which they and their anesthetists are most familiar, and the most important rule of all is to make the anesthesia as brief as possible. The shock of prolonged anesthesia, as such, appears to have far more deleterious effect upon the patient whose kidneys are gravely diseased than the specific action of the anesthetic used.

CHOICE OF OPERATION

Inasmuch as the patient's life often depends upon the rapidity of the operation, the simplest operation is always the best. Although many special types of operations are described, the surgeon who makes the most precise diagnosis and who is most familiar with the simple routine procedures described in the subsequent chapters, will achieve far better results than he who attempts fantastic or complicated procedures.

CARE OF THE KIDNEYS AFTER OPERATION

When hexamethylenamin has been administered for several days before operation, its antiseptic action may be depended upon to continue for two or three days thereafter, and its routine administration resumed on the second or third day after operation. It should be continued thereafter until all danger of infection has passed, or until the existing infection has been controlled. The cardinal rule for the after-treatment of all grave cases of renal surgery is to administer plenty of water. Inasmuch as the patient can drink but little water during the first day or two, when his kidneys are in greatest need of it, the surgeon will do well to adopt some routine procedure for administering large quantities of water immediately after operation. I frequently wash the patient's stomach out while he is still on the operating table, and leave some 200 c.c. of water in the stomach; but, more important than this, is *hypodermoclysis:* 500 c.c. of salt solution may be administered into the pectoral region without doing him any harm, and with less difficulty than intra-

[1] Thompson and Kemp, *Medical Record,* 1898, liv, 325.

venous infusion can be performed. This should be employed as a routine procedure after prostatectomy, as Young has very justly pointed out, and it is equally useful after any operation, when the patient's vitality is low or his kidneys gravely diseased. A single hypodermoclysis usually suffices. The operation may be repeated once or twice thereafter, at intervals of twenty-four hours; but if the need of water is felt beyond this period, it is best administered by rectal enemata, or else by the mouth. Apart from such routine stimulation as may be required to carry the patient through the immediate shock of anesthesia, the administration of stimulant drugs, such as strychnin, nitroglycerin, adrenalin, or digitalis, is very rarely called for; and alcohol, on account of its evil effect upon the kidneys, is better dispensed with entirely unless the patient's previous alcoholic habit absolutely requires it.

DRAINAGE

Drainage is provided for in a special manner by the operative technic of each procedure to be described. *Continuous irrigation of the bladder* by means of double-current drainage-tubes, suprapubic or perineal, is often of the greatest importance to carry away infection descending to that viscus from above, or originating in it, and also to prevent the accumulation of clots. The unfamiliar surgeon will do well to apply continuous irrigation to all his bladder cases, until familiarity with the procedure shall have taught him those cases in which it may safely be dispensed with. It is, generally speaking, not necessary to continue it more than a few hours after bleeding has ceased. The solution employed is a 1-per-cent solution of boric acid, kept at a temperature of 110° to 115° F. in the supply tank and allowed to issue from this drop by drop. The supply tank should be hung only high enough to make the solution flow.

The Retained Catheter.—One of the most valuable ways of providing drainage for the bladder, both before and after operation, is by the retained catheter (indwelling catheter, catheter tied in, catheter *à demeure*).

The indwelling, or retained, catheter or sound is employed either for dilatation or for drainage. For the former purpose, filiform bougies are tied into the urethra; for the latter purpose, silk or rubber catheters are employed. *No metal instruments should be tied into the urethra,* for fear of causing severe ulceration of the walls of the canal.

Antisepsis.—Before introducing the retained catheter, the anterior urethra should be thoroughly irrigated with a 1 : 4,000 solution of permanganate of potash, and the glans penis scrupulously cleansed with soap and water and bichlorid.

The *technic of the retained catheter* has been minutely explained by Guyon.[1] His rules may be summed up as follows:

1. The instrument employed should be large enough to permit a free outflow of urine, and small enough not to make any pressure along the canal. Its eye must be near the end. Metal and olivary instruments are useless. The simple rubber catheter or woven catheter should be employed.

2. The instrument must be introduced only so far as to have its eye just within the bladder. When the catheter is properly placed the urine flows continuously from it, drop by drop. When the retained catheter proves irritating this is usually because it has been introduced too far or not far enough, and is not draining the bladder properly.

3. The method of fixation is described below.

4. While the catheter is to remain in place the penis should be laid up over the groin, to prevent ulceration at the peno-scrotal angle.

5. Cleanliness is insured by using a clean catheter in the first place, by changing the catheter and cleansing it and the urethra every few days, by using daily irrigations of the bladder, by wrapping the penis in a wet dressing of bichlorid (1:10,000), and by using an aseptic urinal. An ordinary glass bed urinal will suffice. A rubber tube is led into it from the catheter, and a little (1:40) carbolic solution kept in the vessel. The urinal is to be scoured and boiled daily.

When the retained catheter acts efficiently it reduces urinary fever and septicemia. When it acts inefficiently it produces them. Inefficient action may be due to plugging of the catheter by pus or blood, or to an idiosyncrasy of the patient.

Fixation.—The female urethra is so short that an indwelling catheter in it must be of the self-retaining type (Fig. 149). Self-retaining catheters are of no value in the male urethra. In the female, the catheter is held in place by tying a number of silk strings to it as it issues from the vulva and fixing these to the pubic hairs in front, and by means of adhesive strapping to the lateral gluteal creases behind.

Fixation in the male varies according to the instrument used. Fixation of a filiform may be accom-

Fig. 149.—Pezzer Self-retaining Catheter.

[1] "Leçons cliniques," 1897, iii, 328.

plished by tying a silk suture about it as it issues from the meatus, tying the ends of this suture together at a point about 1 cm. distant from the bougie, and then running the ends about the coronary sulcus and tying them above (Fig. 150). A catheter is, however, too heavy to be held by this method. It may best be retained by the dressing devised by Dr. Sinclair.

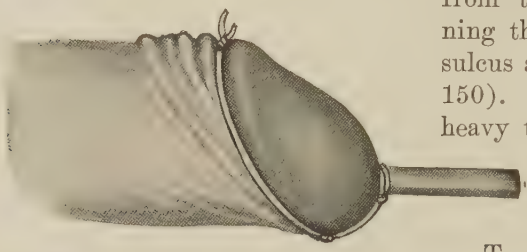

Fig. 150.—Filiform Bougie Tied In.

Two pieces of adhesive plaster are cut into small rectangles, of which the long diameter will just surround the catheter, and the short diameter is about 1 cm. From the long edge of this rectangle two strips extend for about 10 cm. and are infolded so that they will not stick. The resultant product resembles a pair of trousers. The rectangles are affixed about the catheter close to the meatus, so that the "trouser legs" extend over the body of the penis at four equal angles. The shaft of the organ is then surrounded without compression by a band of adhesive plaster about 2 cm. in width, the legs of the catheter bands pulled down over this (Fig. 151) and fixed by means of another strip of adhesive plaster. Before this is made adherent, each of the legs is pulled taut. Brief compression then fixes the outer band of adhesive plaster over these. The solidity of the fixation is insured by wrapping a silk string three or four times about the adhesive plaster on the catheter and tying it tightly.

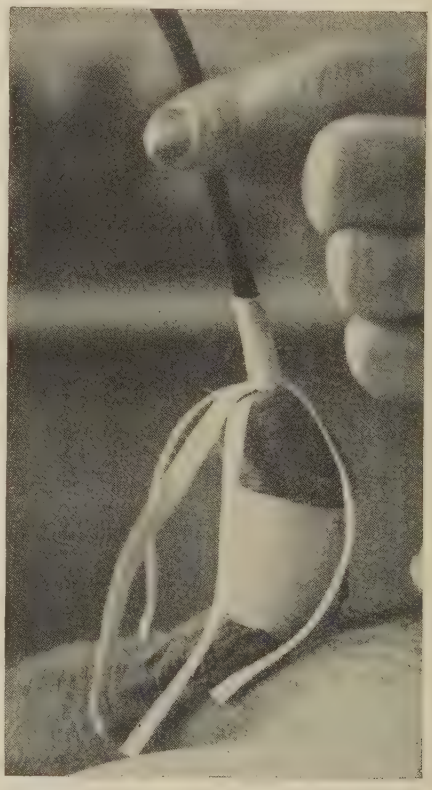

Fig. 151.—Sinclair's Method of Fixing Retained Catheter.

Position of the Penis.—If a silk catheter is used, the penis must lie over the groin; otherwise ulceration at the peno-scrotal angle will result. If a rubber catheter is used, no attention need be paid to this detail, but the end of the

catheter may be permitted to drop into a urinal situated between the patient's thighs. This urinal should be sterilized, and catheter and urinal surrounded by the folds of a sterile towel.

Requisites for Success.—In order that the catheter shall work properly, it is necessary that it should fit loosely but snugly in the urethra (about size 17 French); that its tip should remain in the bladder; and that it should be changed every three to six days, according to the irritation it excites. While the catheter is in place, the bladder should be irrigated at least once a day, and when it is changed the anterior urethra should be thoroughly flushed with permanganate solution.

The catheter always excites a mild urethritis, and sometimes great protestations of pain from the patient; but if the urine drips from it regularly, it is well to quiet the patient for the first twenty-four hours by assurances and narcotics, after which his objections will usually cease; but if the bladder persistently expels the catheter, or if the patient protests too loudly, or if fever results, it cannot be employed.

CHAPTER LXXX

OPERATIONS UPON THE KIDNEY

SURGICAL ANATOMY

Gross Anatomy.—Although familiarity with the minute anatomy of the kidney is an essential part in the equipment of every practitioner, be he physician or surgeon, it is quite impracticable to enter upon this intricate subject here. A brief survey of the gross anatomy of the organ must suffice. The rest we leave to the histologist.

The kidney is ovoidal in shape, flattened antero-posteriorly, and with a deep notch, the *hilum*, in its inner border. The renal vessels and nerves enter the organ through the hilum, the vein lying in front of the artery, while behind these is the conical *pelvis*,[1] terminating below in the ureter. The *sinus* of the kidney is the irregular cavity of which the hilum is the orifice.

The normal kidney is 11 cm. long, 6 cm. wide, and 4 cm. thick. It weighs from 125 to 200 grams.

The kidney is closely surrounded by a fibrous capsule sending fine processes between the secreting tubules. A thin, irregular layer of unstriped muscle lies between the capsule and the kidney. When the organ is healthy its capsule may be stripped from it, but inflammation causes the capsule to become adherent.

A vertical section through the kidney (Fig. 152) shows its secreting structure to consist of two parts: an outer (cortical) portion and an inner (medullary) portion, the latter made up of rounded cones (pyramids) whose apices (papillæ, mammillæ) project into the sinus of the kidney; while between the medullary pyramids the lighter-colored cortical portion of the organ also abuts on the sinus.

The Renal Arteries.—The *renal arteries* are given off one from each side of the abdominal aorta, and proceed directly outward to the kidney, lying behind the veins (the right renal artery runs behind the inferior vena cava). As the artery enters the hilum of the kidney it divides into

[1] Although, strictly speaking, the pelvis is the dilated upper extremity of the ureter, it is customary and convenient to speak of the renal pelvis rather than the ureteral pelvis.

several branches, which enter the cortical substance and are thence distributed throughout the organ. The arterial supply of the kidney is peculiar in that the vessels do not anastomose. The small vessels subdivide from the main branches that enter between the pyramids and in front of the pelvis.

Hyrtl has shown that the arterial system is divisible into two parts: a more important anterior system, supplied by the main branches of the renal artery, and a posterior system, supplied usually by a single branch, the retropyelitic, that passes around above the pelvis, and, running down upon the posterior surface of this, sends branches into the posterior part of the kidney. Exceptionally, the retropyelitic artery passes below the pelvis. The terminal distribution of the anterior and posterior branches of the renal artery is neither definite nor fixed, but, generally speaking, the anterior branches supply a little more than the anterior half of the organ. Therefore, in order to incise as few arterial branches as possible, the kidney should be opened in a vertical line about 0.5 cm. back of the median plane of the organ.

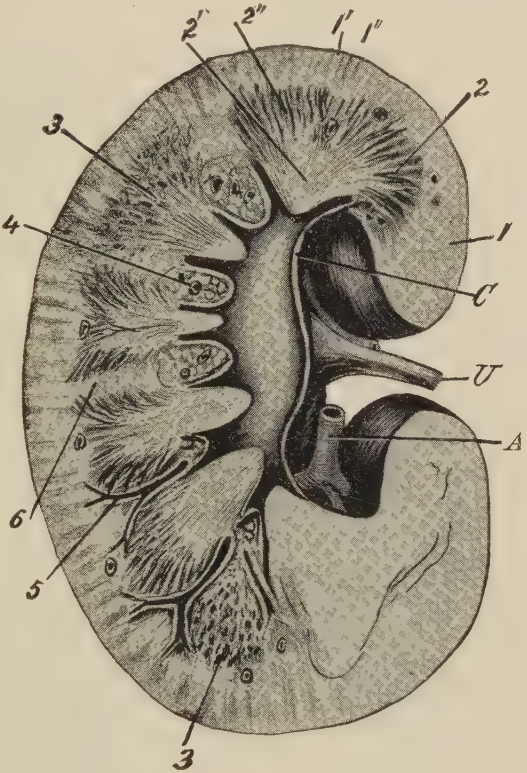

FIG. 152.—FRONTAL SECTION THROUGH THE KIDNEY, PELVIS, AND CALICES (Henle). *A*, branch of the renal artery; *U*, ureter; *C*, calyx; 1, cortex; 2′, medulla; 2″, boundary zone; 4, fat of sinus of kidney; 5, arterial branches.

Veins, Nerves, Lymphatics.—The *renal veins* accompany the arteries, lying in front of them, and empty into the inferior cava. On the left side, the spermatic, inferior phrenic, and suprarenal veins are tributaries of the renal.

The *nerves* of the kidney are derived through the renal plexus from the solar plexus, the semilunar ganglion, and the lesser and smallest splanchnic nerves. The spermatic plexus is derived from the renal plexus.

The *lymphatics* accompany the blood-vessels and empty into the lumbar glands.

Position.—The kidneys lie on each side of the spine in the upper lumbar region, behind the other viscera and outside of the peritoneal cavity (Fig. 153). They rest on the diaphragm and the psoas magnus and quadratus lumborum muscles between the twelfth dorsal and the third lumbar vertebræ. Their upper extremities lie nearer to each other than the lower, and the internal borders face a little downward and forward, the outer borders upward and backward. The right kidney lies rather lower than the left on account of the position of the liver above it (Fig. 154).

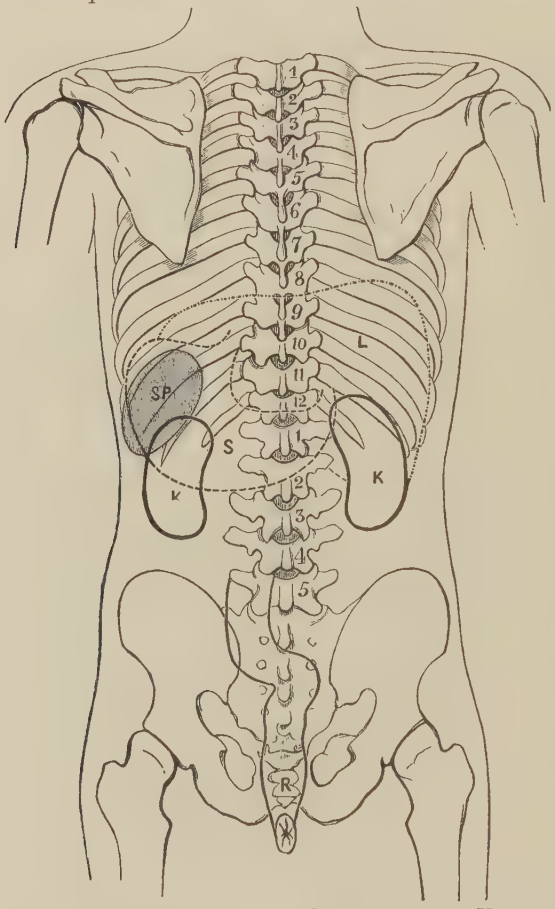

Fig. 153.—Diagram Showing Relation of the Viscera to the Parietes, Posterior View (Treves). S, stomach; L, liver; K, kidney; sp, spleen; R, rectum.

The average normal variation in the position of the kidneys is well expressed by Brewer's [1] statistics obtained in the dissecting-room. He found the upper end of the right kidney opposite the eleventh rib in 78 cases, opposite the twelfth rib in 62 cases, and lower still in 9 cases. The upper end of the left kidney was opposite the tenth rib in 1 case, opposite the eleventh in 100 cases, opposite the twelfth in 43 cases, and below the ribs in 6 cases. Yet it must be borne in mind that during life the kidneys move up and down with every respiration, and are peculiarly susceptible to downward displacement.

Fatty and Fascial Envelope.—The kidney, surrounded by its fibrous capsule and topped by the adrenal, lies embedded in a mass of loose cellular tissue, usually containing a considerable amount of fat, and calculated to permit slight changes in its size and position. This fatty envelope (perirenal fat) quite fills the hollow of the loin, and is

[1] *Med. News*, 1897, lxxi, 129.

surrounded and held in place by a distinct fascia. This fascia has been studied by Zückerkandl, Gerota, and Glantenay and Gosset.[1] It completely surrounds the kidney, the suprarenal capsule, and the perirenal fat. In front it blends with the subperitoneal fascia, internally it adheres to the vertebral column, and above to the diaphragm. It sends a few fibers to the aponeurosis of the quadratus lumborum which lies immediately behind it. It thus forms a distinct sac firmly anchored to the diaphragm and the spine. It is everywhere closed, except at its

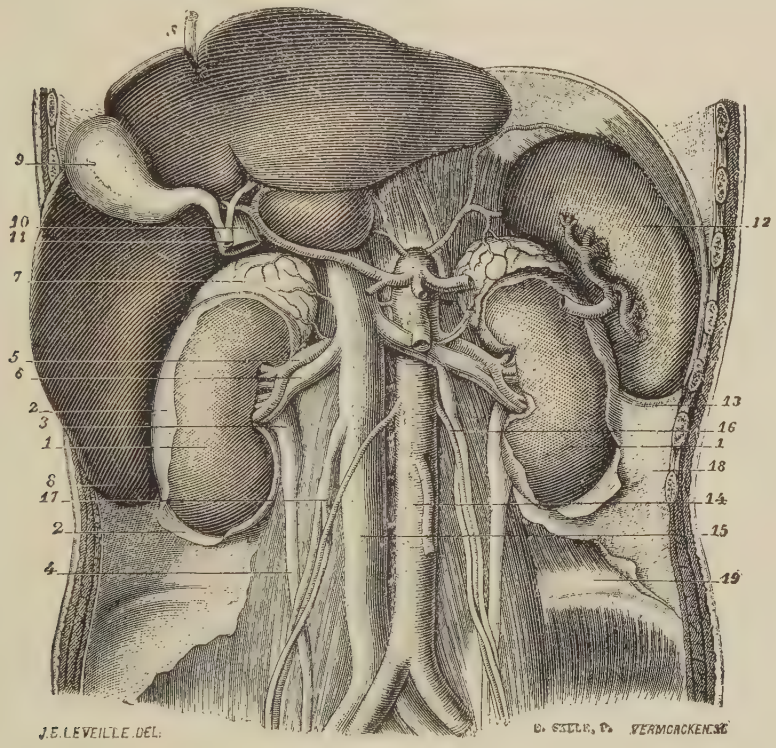

FIG. 154.—SITUATION, DIRECTION, FORM, AND RELATIONS OF THE KIDNEYS (Sappey). 1, 1, the two kidneys; 2, 2, fibrous capsule; 3, pelvis; 4, ureter; 5, renal artery; 6, renal vein; 7, suprarenal capsule; 8, the liver lifted up; 9, gall-bladder; 12, spleen; 14, abdominal aorta; 15, inferior vena cava; 16, left spermatic artery and vein.

lower extremity, where the posterior layer thins out and sends only a few fibers across to the subperitoneal fascia. (Were it not for this hiatus floating kidney would be impossible.) Below and behind this fascial envelope lies another mass of fat, practically continuous with the perirenal fat, but distinguished as the *pararenal fat.*

Relations.—Behind, the kidney is in relation with the diaphragm and the psoas and quadratus muscles. The last dorsal nerve runs trans-

[1] *Guyon's Annales,* 1898, xvi, 113.

versely between the muscles and the perirenal fascia, and the pleura usually descends between the ribs and the diaphragm low enough to cover the upper third of the organ.

In front of the right kidney lie the duodenum and the ascending colon. A fold of peritoneum separates kidney and liver above the colon, while lower down a peritoneal fold separates colon and duodenum.

The left kidney is crossed by the tail of the pancreas and lower down by the descending colon, while its upper portion is separated from the stomach by the lesser sac of peritoneum.

The upper extremity of each kidney is capped by the adrenal. In fetal life this is closely adherent to the kidney and almost completely envelops it, but after birth the adherence becomes slight.

The Pelvis of the Kidney.—The pelvis belongs anatomically to the ureter, of which it is the dilated upper extremity, but surgically to the kidney, of whose secretion it is the reservoir and in whose surgical diseases it participates.

At the bases of the renal pyramids the epithelium of the uriniferous tubules joins with the fibrous covering of the cortex, the one to form the inner, the other the outer, coat of a tube surrounding one or more papillæ, and called a *calix* (infundibulum). The calices unite to form the pelvis, an irregularly funnel-shaped pouch which protrudes from the lower and back part of the hilum, whence it runs downward, narrowing rapidly to become the ureter proper at a level with the lower end of the kidney.

The structure of the pelvis resembles that of the ureter (p. 499).

The radiographs, Fig. 106 and Plate VI, illustrate the great diversity in shape and size of the normal kidney pelvis. Generally speaking, the pelvis splits up into two main calices; the upper one long and thin, extending obliquely upward to the top of the kidney, the lower one shorter and thicker, extending transversely. Each of these subdivides into several secondary calices, as the illustrations show. Manifestly, therefore, when the kidney is incised for the purpose of reaching the pelvis, it is wiser, other things being equal, to make the incision in the lower pole, both because the lower calix is broader and more readily accessible, and also because it is usually large enough to admit the finger, which the upper calix may not be.

Relations of the Vessels to the Kidney Pelvis.—The main renal vessels lie in front of the kidney pelvis and extend from the kidney in a direction upward and inward, while the pelvis, which lies behind, drops almost directly downward. The only vessel of importance lying behind the pelvis is the retropyelitic artery, which, as stated above, supplies the posterior portion of the kidney.

Inasmuch as there are no internal anastomoses in the renal arteries, division of this artery may occasion necrosis of almost half the kidney.

It is, therefore, important to be on the lookout for it whenever the pelvis is incised; but happily it usually skirts the upper edge of the pelvis within the hilum of the kidney, so that, ordinarily speaking, it is not seen.

PREPARATION FOR OPERATION

The preparations for operation upon the kidney are, generally speaking, those for any major, general operation. The patient's general condition should be in the best possible state, and the diagnosis of the state of the renal function, of the pathological condition of the kidneys and of the condition of the other vital organs, should be most carefully studied.

The study of the renal function should be made along the lines already laid down, and it is excellent rule to perform radiography, ureteral catheterism, and study of the renal function upon every patient whose kidney is to undergo operation. Under certain circumstances any or all of these tests may have to be omitted, but one can never tell beforehand which is the case that may absolutely require every diagnostic test. The recent confession of a noted surgeon that, in his second series of 100 operations upon the kidney, he was mistaken in his diagnosis quite as many times as in the first 100 cases, is but an expression of the great uncertainty of renal surgery, which uncertainty can only be lessened by familiarity with and constant application of every device for accurate diagnosis before the patient comes to the operating table. (See Chapter LXXIX.)

LUMBAR INCISION

Position of the Patient.—For such minor operations as drainage of perirenal accumulations of pus and urine, or nephropexy, the patient may lie upon the abdomen, since the operation may be performed through a vertical dorsal incision, but the only advantage of this position is that it saves a little time if both kidneys are to be operated upon. The almost universal custom is to place the patient upon one side, with the hip and knee of the under leg well flexed so as to prevent the trunk from tumbling over, and the knee and hip of the upper leg extended, both for the purpose of retaining the balance and for the purpose of still further increasing the size of the lumbar recess. To increase the size of this space still further, and to push the kidney upward and make it more accessible in the loin, it is necessary to place some form of pillow or bolster underneath the opposite loin of the patient. A large sand bag or pillow will serve this purpose; the Edebohls kidney bag serves better; and the appliances for this purpose fitted to all modern operating tables serve best of all, since these appliances may be raised or lowered

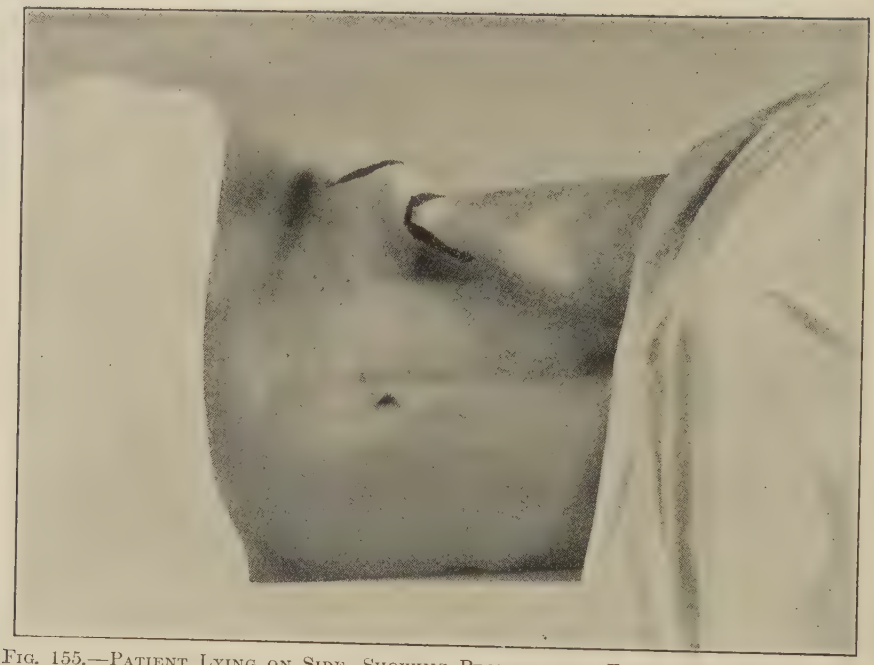

Fig. 155.—Patient Lying on Side, Showing Proximity of Free Border of Ribs to Crest of Ilium.

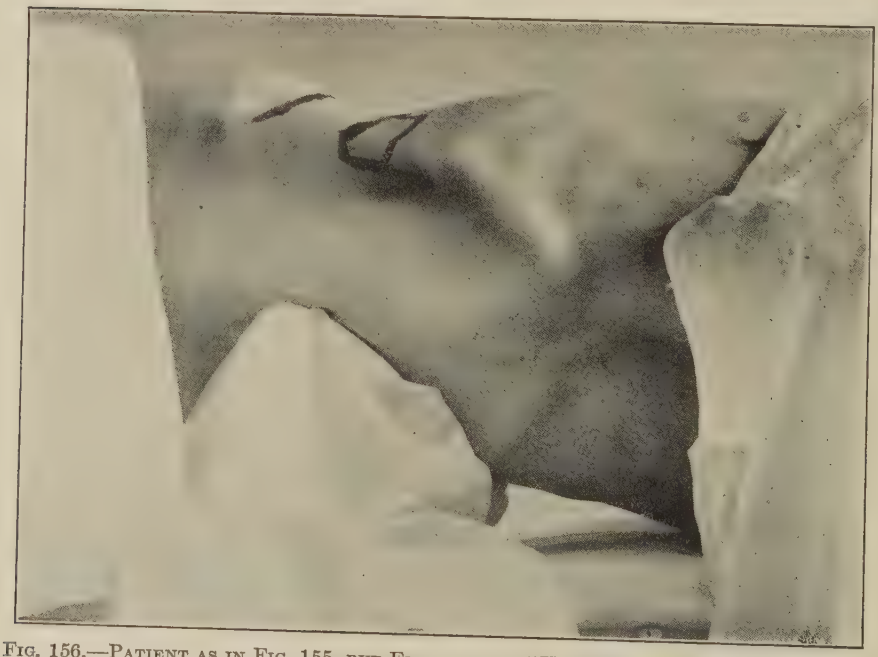

Fig. 156.—Patient as in Fig. 155, but Elevated by "Kidney Support." Note how the ribs are drawn away from the iliac crest. The space between is widened by the interval included in the ɑ.

and the patient, placed upon the flat table, may be raised into proper position during the operation, and dropped back upon the table again when the muscles are to be sutured. The elevation should be such as to put the upper loin upon the stretch, but not really to lift the weight of the patient's body from the hip and shoulder resting on the table. The arms should be disposed in front of the patient.

The Incision.—Three incisions are in favor. In the order of importance they are:

The oblique incision.
The transverse incision.
The vertical incision.

The Oblique Incision.—The surgeon, standing behind the patient, determines the position of (1) the tip of the last palpable rib (which may be the eleventh or the twelfth); (2) the outer edge of the mass of spinal muscles; and (3) the upper border of the iliac crest. The incision is begun one finger's breadth below and two fingers' breadths behind the tip of the rib and carried obliquely down and forward to pass one or two fingers' breadths above the upper edge of the iliac crest, from which it can be carried still farther down and forward parallel with that crest, if necessary. The incision should always be long enough to admit the whole hand. It may be curved slightly downward, though this is no great advantage.

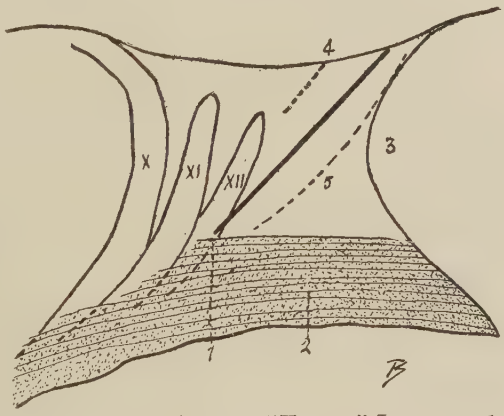

Fig. 157.—The Oblique "Kidney" Incision. 1, costo-muscular angle; 2, quadratus and spinal muscles; 3, iliac crest; 4, last dorsal nerve; 5, ilio-hypogastric nerve; X, XI, XII, ribs.

The reason for beginning the incision below the last rib is that the twelfth rib may be rudimentary, in which case the pleura, which often descends below the level of the eleventh rib, might be wounded if the incision were made upon that bone. The reason for beginning the incision well behind the tip of the rib is to avoid the last dorsal nerve, which issues out of the abdominal cavity at a point about level with the tip of the rib (Fig. 157).

Actually, the incision begins close to the mass of spinal muscle. After incising the superficial tissues, the external oblique is reached; and if an easy operation is anticipated, this muscle may be thrown forward and the dissection continued between it and the spinal muscles in Petit's triangle. The next plane reached is that of the internal oblique

and transversalis. If the kidney is known to be very loose, these muscles need not be divided, but may be separated on a plane parallel with their fibers.

This muscle-splitting operation gives, however, a very restricted field, and in the great majority of instances it is necessary to divide all the abdominal muscles in line with the external incision. If the division is made sufficiently far back, the twelfth dorsal nerve is not seen; if the incision is sufficiently oblique and high above the iliac crest, the ilio-inguinal and ilio-hypogastric nerves are either not seen at all, or are seen to run parallel with the incision and below it. None of these nerves should be divided.

After dividing the fascia of the transversalis, a mass of retroperitoneal fat appears in the incision. This is pushed down and blunt dissection made in a backward and upward direction. This brings the perirenal fat into the wound, surrounded by its fibrous capsule. Since this fibrous capsule closely resembles the peritoneum, the inexperienced surgeon will do well to thrust his hand into the incision along the muscles of the back, and then, palpating forward against his other hand on the anterior abdominal wall, he will feel the kidney, and, feeling this, will be sure that the tissue in question is the fascial capsule of that organ. This fascial capsule is drawn into the wound by a clamp, divided with scissors, and split longitudinally by the fingers.

If the kidney is quite loose, it may be drawn into the wound by catching the perirenal fat which now bulges out, and drawing it out, both in front and behind, with retractors, while the fingers strip it from the surface of the kidney; but if the kidney is adherent, this procedure is of no avail. The hand must be plunged into the loin and blind, blunt dissection made with the fingers, both in front and behind the kidney.

The first object sought is to clear away the upper pole of the kidney. With the fingers close to the organ, adhesions are broken up and the perirenal fat pushed aside until the upper pole is reached; then the fingers are swept around this, both behind and before, until it is quite free. The upper pole is then released and the lower pole much more readily freed in like manner.

An attempt is then made to draw the kidney up into the wound, either by traction upon the perirenal fat and capsule, or by traction upon the kidney itself. If the maneuver is difficult, it may often be facilitated by turning the kidney backward, inspecting its anterior surface, and carefully incising adhesions that bind it to the surrounding tissues, pushing these away and so advancing, little by little, until the hilum is reached. The same procedure is then employed for the posterior surface of the kidney, and for its extremities as well. Finally, when all adhesions have been freed, the kidney readily pops out of the

wound, unless bound down by considerable inflammation about its hilum.

The chief difficulty in these manipulations is due to the insufficient size of the wound. If the surgeon finds he cannot move about freely, he may now enlarge the wound upward to reach the last rib, if he takes the simple precaution of stripping back all the tissues below the muscular layers before incising these. But a much greater space can be obtained by enlarging the lower end of the incision; and although it seems contradictory to enlarge the incision downward for the purpose of reaching an organ which lies above the upper end of the incision, this maneuver, nevertheless, achieves its purpose.

The Transverse Incision.—This incision is employed either alone or as an addition to the oblique incision, for the purpose of getting at densely adherent or unusually large kidneys. The incision is carried parallel to the last rib, and a finger's breadth below it from the edge of the lumbar muscles nearly to the external edge of the rectus. The incision is carried down to the peritoneum, which is dissected forward until the kidney is disclosed lying in its fascial envelope. This is opened, and the kidney freed as above described.

The Vertical Incision.—The vertical incision, running directly downward from the twelfth rib to the iliac crest, gives a field too restricted for most operations. It may be employed, however, for nephropexy, and has the advantage of sparing the lateral and anterior abdominal walls.

Variations in the Operation.—Many other types of incision have been suggested, but the three mentioned above are the only ones currently employed.

The oblique incision may be extended downward, for extraperitoneal exploration of the ureter, as far as the brim of the pelvis. If intraperitoneal complications are suspected, the peritoneum may be deliberately incised and the gall-bladder, the intestines, or even the appendix, inspected, while the hand may be run across for intraperitoneal palpation of the opposite kidney—a procedure, by the way, which very rarely discloses anything worth knowing. That the opposite kidney seems sound on palpation is no evidence that it has any appreciable functional capacity.

Accidents in the Operation.—*The peritoneum* may be torn, but this is an unimportant accident, even if it cannot be adequately sutured. If the kidney or the perirenal tissues are infected, peritonitis may be prevented by adequate drainage.

Injury to *the pleura* is prevented as described above. Its occurrence is characterized by the whistle of the air drawn in at inspiration and the bubbles that appear in the wound at expiration. The tissues should be quickly clamped and the rent closed by sutures, turning in the surrounding fascia.

A more common complication of the operation is partial *rupture of the kidney* during the efforts at separating it from the surrounding tissue. This accident is discussed under the head of subcapsular nephrectomy.

TRANSPERITONEAL OPERATION UPON THE KIDNEY

Premeditated opening of the perineal cavity for operation upon the kidney is very rarely done. A surgeon may operate upon an obscure abdominal mass and find, after he has entered the peritoneal cavity, that it is a hydronephrosis or a pyonephrosis; and in this event it may be wiser to stitch the sac to the anterior peritoneal wall, and then to open it transperitoneally, or it may be preferable to close up the anterior incision and to attack the sac through the loin.

Transperitoneal nephrectomy is appropriate only to extremely large growths. I have twice performed it for removal of Wilms's tumor of the kidney. The best incision is a vertical one at the outer border of the rectus, which may be enlarged by a transverse incision running to the loin. If there is any danger of infection of the peritoneal cavity, the classical advice is to make an incision in the posterior layer of the peritoneum, external to the colon and comparable in size to the incision in the anterior layer of the peritoneum, to suture these two layers together, and then to proceed with the operation, which is thus rendered extraperitoneal. In practice, such a procedure is rarely employed. If there is danger from infection, it is better to close the peritoneal incision, and then to proceed by the lumbar route; if not, there is no need of walling off the peritoneum.

CHAPTER LXXXI

OPERATIONS UPON THE KIDNEY (*Continued*)

NEPHROTOMY

The Operation.—The kidney is laid bare through the oblique lumbar incision in the manner described above. The vascular pedicle is then compressed.[1] If the kidney has been well freed, it is usually easy to perform this compression between the two hands of an assistant, who feels the renal artery and makes pressure upon it by passing his hands into the wound, one in front of and one behind the kidney. If enucleation has only been partial, and the pedicle is not well freed, the compression must be made either by the fingers of an assistant, who presses the renal artery against the psoas muscle, or by means of a long intestinal clamp with blades protected by rubber tubing. In placing the clamp, care should be taken to avoid the ureter, and for this reason it is better, if possible, first to free the ureter from the mass of the renal pedicle and then to place the clamp. The kidney is now incised according to the indications of the particular case in question. Other things being equal, the incision should always be made parallel to the long axis of the kidney and preferably about 5 mm. ($\frac{1}{4}$ inch) posterior to its median line, since this is the region that contains least blood-vessels. Unless there is some special indication for opening the superior calix, the best incision is that devised by Albarran:

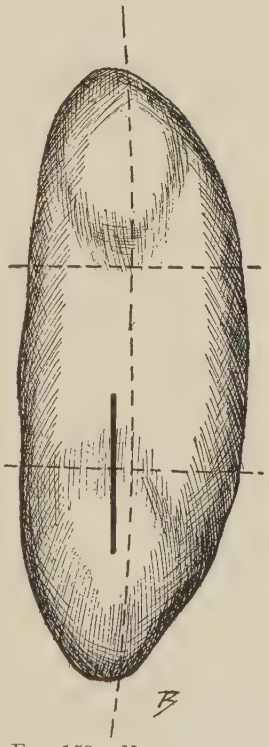

FIG. 158.—NEPHROTOMY INCISION.

[1] It has been demonstrated (cf. *Trans. Am. Ass'n Gen.-Urin. Surg.*, 1909, vol. iv.) that compression of the renal pedicle, especially by instruments, causes anuria which may last many hours. Hence some surgeons prefer never to compress the pedicle.

With a plunge of the bistoury to the depth of 3 cm., the surgeon incises the convex border of the kidney 5 mm. back on its posterior surface. The incision should begin 2.5 cm. above the junction of the middle and inferior third of the kidney, and is prolonged for an equal distance below that point. Separation of the wound surfaces exhibits the section of the gray mucous membrane of the inferior calix, which has been opened. This opening is enlarged with the scissors sufficiently to admit the finger without tearing the kidney tissue.

The finger is then introduced into the pelvis of the kidney, whence it can be passed well up into the superior calyx and the whole interior of the organ explored, counter-pressure being made from without. If there is question of the permeability of the ureter or of the presence of stone in that duct, a ureteral catheter is passed down into the bladder. This catheter must pass at least 25 cm. before one can be sure that it has actually entered the bladder.

This investigation is sufficient to disclose stone in the urinary passages, but it is not sufficient to determine absolutely the question of slight beginning tuberculosis of the kidney. If this is suspected, but the preoperative diagnosis has not been absolute, the kidney may be split from end to end and its parenchyma carefully examined for minute tubercles, while the exposed surface of the pelvis is searched for ulcerations. If doubt still remains as to any point of the diagnosis, a thin sliver of kidney tissue may be removed from the face of the incision, or from the outer surface of the organ.

Suture of the Kidney.—If the kidney is known to be uninfected, it may be sutured without drainage. If infection is known to exist, or is feared, it should be sutured around a small rubber drainage-tube.[1]

To close the kidney incision, a heavy, plain catgut suture should be passed through and through on a large, curved needle, in such a way as to penetrate to the depth of the wound. These sutures should be placed about 0.5 cm. ($\frac{1}{4}$ inch) apart. After they have been placed the pressure on the renal pedicle is released, the two edges of the wound pressed tightly together, and the sutures tied. If heavy catgut is not at hand, a doubled strand of light catgut may be used for each suture. Between each of these deep sutures the line of incision is then further closed by the addition of a superficial suture which penetrates only about 1 cm. into the kidney. The kidney is then returned to its place in the loin, a small drainage-tube inserted down to the kidney, and the abdominal wound sutured.

Operative Difficulties.—The incision in the kidney may not lead directly into the pelvis, but may pass to one side of this and open the

[1] Cunningham has shown that in dogs postoperative anuria lasts much longer if the kidney is sutured than if drainage is employed.

sinus of the kidney. By carefully opening the wound, after making the first incision, the accident is discovered, and the pelvis is picked up and opened with scissors. If, in palpating the kidney with the finger in the pelvis, a lump is felt in the body of the gland, this may be diagnosed by driving a needle into it to disclose stone; or, if neoplasm is suspected, the lump may be excised. In palpating the pelvis, enlarged glands or masses of indurated fat may be felt like stones.

Postoperative Complications.—The only peculiar postoperative complication is hemorrhage. Although the hemorrhage resulting from incision of the kidney is alarming to the unaccustomed surgeon, it may be thoroughly controlled by compression of the pedicle and by the subsequent suture of the organ, unless the kidney is chronically inflamed; but prolonged chronic nephritis produces changes in the organ which make it bleed profusely and make this bleeding very difficult to stop. In not a few instances, postoperative hemorrhage has either carried off the patient or called for immediate secondary nephrectomy under most trying circumstances. For this reason it is that we prefer to incise the pelvis of the kidney whenever this is possible, rather than the parenchyma, unless the organ is nearly normal.

PYELOTOMY

The kidney is exposed and liberated as usual. After it has been brought up into the loin, palpation of the region immediately beneath its lower pole, and of the area extending downward from this along the peritoneum, reveals the cordlike ureter. The fascia is stripped from the posterior surface of the upper part of the ureter, leaving it attached in front to the peritoneum, and the fascia is also stripped from the posterior surface of the pelvis of the kidney, care being taken to avoid the retropyelitic artery. The pelvis is now incised in a line radiating from the mouth of the ureter toward the hilum of the kidney. This incision is made large enough to admit the little finger of the surgeon, with which the interior of the cavity of the pelvis is then explored. Through this same incision a ureteral probe may be passed down into the bladder, while stones may be extracted and bleeding papillæ may be identified and curetted.

In order to identify a bleeding papilla, it may be necessary to compress one portion of the organ after another in order to find, in a general way, where the papilla is. Having learned this, it may be necessary to make quite a large incision in the pelvis, and even into the kidney itself, in order to pull apart the edges of this sufficiently to show the bleeding point. Once seen, this is thoroughly curetted. The wound in the pelvis is closed by fine catgut sutures through and through. There is rarely

any need to drain the pelvis, but this may be done by means of a small catheter without fear of resulting fistula.

Wounds of the pelvis of the kidney may be expected to heal by first intention, if properly sutured, but a tube should always be run down to the site of the suture for fear of a break. Urinary fistula from the pelvis is not likely to continue for more than two weeks. It may be controlled by the indwelling ureter catheter.

NEPHROPEXY AND DECAPSULATION OF THE KIDNEY

The Operation.—The methods of performing nephropexy are innumerable. The essentials to a good operation are:

(1) All of the perirenal fat between the kidney and its fascial envelope should be removed, in order that the kidney may form adhesions with the fascial envelope which shall hold it tightly in place; (2) the kidney should be fixed in such a way that its position shall be as normal as possible, its ureter and vessels not kinked, and itself held as high as possible up under the ribs; (3) the sutures by which the kidney is held should not so restrict its mobility that its vessels may become kinked after operation; (4) sutures should not pass through the kidney tissue itself, but the organ should be held in place either by gauze packing below it or by sutures passed through its capsule.

Of the two methods of retaining the kidney in place, sutures through the capsule are far preferable to gauze packing below the organ, not because they hold it any more firmly, but because they permit immediate closure of the wound.

Edebohls's Operation.—The method of Edebohls is the one now almost universally employed. The operation was performed by Edebohls through a vertical incision; but the oblique incision may be employed. The perineal fascia is then incised and pulled well up into the wound, the fat separated from the kidney before and behind and carefully excised, leaving only the fascial capsule surrounding the kidney.

Decapsulation.—The kidney is then decapsulated as follows:

While it is held in the wound, a small nick is made in the capsule in the median line near the lower pole. A grooved director is passed through this incision between the capsule and the kidney, and upon it the capsule is slit from one pole to the other along the convex border. Each edge of this incised capsule is then freed from the surface of the kidney by blunt dissection, which is carried halfway down toward the hilum. Two suspension sutures are then placed through the capsule at its point of reflection from the kidney, without penetrating the kidney tissue. The kidney is then replaced in the loin and, if necessary, a little separation is made of the tissues at the upper end of the kidney recess,

in order to permit it to pass freely up under the ribs. Either before or after the kidney is replaced, the pelvis and ureter are carefully inspected to see that they are not compressed or kinked by adhesion to the lower pole of the kidney. The suspension sutures attached to the kidney capsule are then passed through appropriate portions of the parietal muscles and tied.

According to the original Edebohls method, the sutures were of silkworm gut, and were carried up through the skin of the loin to be cut and withdrawn after healing had taken place; but it seems preferable to employ chromic gut and to bury the sutures. In tying the sutures, one must, of course, be careful to tie the ends of each loop to each other.

NEPHROSTOMY

Nephrostomy is an operation upon the kidney for the purpose of deflecting the urine through the loin for a greater or shorter length of time. Albarran mentions the following types of nephrostomy:

Nephrostomy of Calculous Anuria.—The object of this operation is to drain the kidney rather than to remove the calculus. Watson urged the performance of simultaneous double nephrostomy for this condition, and if the condition of the other kidney is doubtful, this is the operation of choice. On account of the patient's precarious condition, the operation should be made as brief as possible, and if any difficulty is experienced in finding or removing a calculus, this should be deferred to a subsequent operation.

Nephrostomy for Nephritis.—For *chronic nephritis* the operation of decapsulation is commonly preferred to that of nephrostomy, since it achieves approximately the same ends without destroying any of the renal parenchyma. If nephrostomy and decapsulation are performed at the same operation, care must be taken to leave enough capsule along the convex border of the kidney to hold the sutures, for these will otherwise tear through the soft parenchyma.

For the hematuria of chronic nephritis, pyelotomy is preferable to nephrostomy, since by it clots may be washed out of the pelvis, the bleeding point sought for, and the papilla curetted. It may be deemed advisable to decapsulate at the same time; but there is nothing to be gained by nephrostomy.

Nephrostomy for Hydronephrosis.—Operation upon a hydronephrotic kidney is always undertaken for the purpose of relieving the obstacle. If this cannot be done, and the condition of the opposite kidney is doubtful, it may seem wise to perform nephrostomy; but if the opposite kidney is in good condition and the course of the urine through the ureter cannot be reëstablished, it is usually wiser to remove the dilated kidney.

Nephrostomy for Pyonephrosis.—When operating upon pyonephrosis in a patient whose opposite kidney is in a condition of doubtful vitality, or known to be gravely diseased, nephrectomy cannot be performed. If the patient's condition is such as to warrant it, ureter catheterism is performed, and the catheter run up as far as possible toward the pelvis of the kidney to be operated upon. The patient is then placed upon his side and the kidney cut down upon.

Albarran advises that the fatty capsule should only be partly stripped away from the kidney, in order to avoid the possibility of pocketing of pus. The incision into the kidney itself is made, if possible, over a soft spot where the parenchyma is thin. This incision is then enlarged sufficiently to permit inspection of the interior of the pelvis. The finger explores this cavity, extracts any calculi that are found there, and opens up badly draining pouches freely into the general cavity of the pelvis. This should be done in plain sight so that, if any considerable vessels are ruptured, they may be caught.

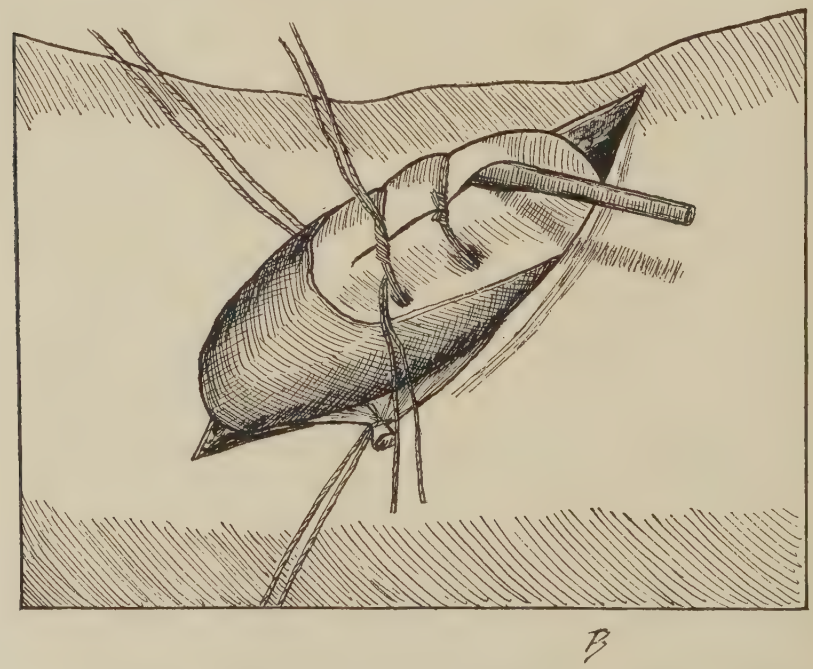

Fig. 159.—Nephrotomy with Decapsulation. A section of the capsule is preserved to hold the kidney sutures. The remainder is turned back and caught in a suspension suture for nephropexy. (After Albarran.)

The orifice of the ureter is then sought for. If the ureter catheter has passed up to the pelvis, or into it, the ureter orifice is readily identified. If not, it may be difficult or impossible to find it. If the ureter orifice is not found, it is wiser to drain the kidney until the patient's

condition shall have considerably improved, when a secondary operation may be performed and the ureteral obstruction dealt with by whatever plastic operation seems appropriate. If the ureter orifice is found, the ureter catheter may be left in place.

Albarran exchanges the catheter introduced by the cystoscope for a large catheter, size No. 12 or 13, pushing this over the tip of the little

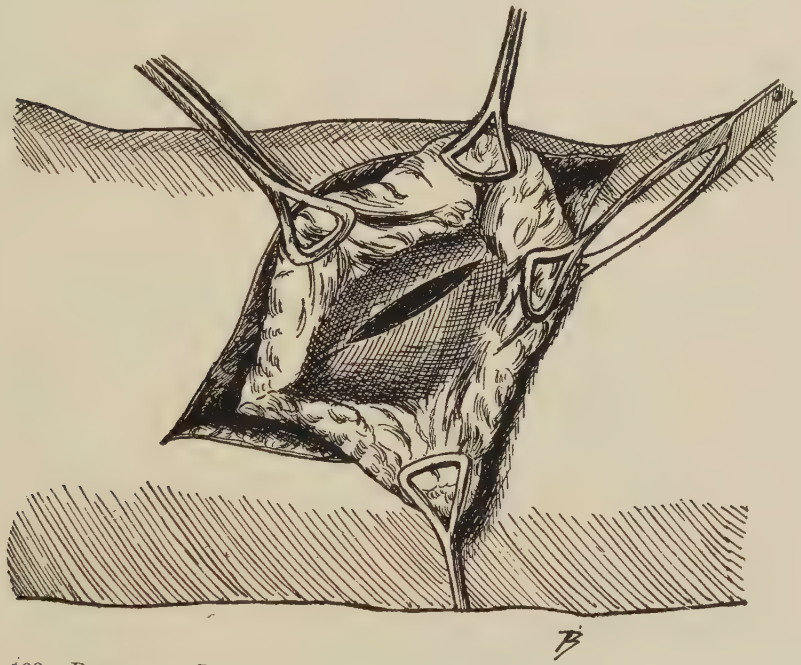

Fig. 160.—Restricted Liberation of Perirenal Fat in Nephrostomy for Pyonephrosis. (After Albarran.)

catheter and pushing the two together into the bladder and out through the urethra. The only permissible attempt at plastic work is to tilt the kidney up in such a way that as little as possible of it lies below the level of the ureteral orifice.

To close the operation, the lips of the kidney incision are partially sutured, while the remainder of the kidney incision is sutured to the muscles of the loin, in order to prevent pocketing of pus. Rubber-tube drainage is required. If the perirenal fat has been torn away freely from the kidney, extrarenal drainage must be provided as well.

Postoperative Care.—The tubes are left in the kidney so long as pus in any quantity continues to drain through them. As soon as the suppuration is well controlled, however, these tubes may be removed, on condition that the ureteral catheter has been left in place. If this has not been done, the kidney must be drained for at least a month and often

for several months. During this time the improvement in the condition of the patient will determine whether a secondary plastic operation shall be performed upon it; but if there is a catheter in the ureter, one may postpone this secondary operation for a considerable time in the hope that the catheter will reëstablish the proper flow of urine.

Albarran leaves the ureter catheter in place from eighteen to thirty days, washing out the kidney twice a day with boric-acid solution or silver nitrate (1 : 1,000). If the catheter works badly, it must be changed; otherwise it may remain in place throughout this time.

If Albarran's large catheters are used, they may be changed by running up into the catheter one of his two-piece mandrins, removing the catheter over this and then reinserting a clean catheter over it. The mandrin must be very well oiled, in order to make it slip easily. The catheter must also be well oiled throughout its caliber when it is reintroduced.

Nephrostomy for Tuberculosis.—This is an operation to be employed only as a last resort, when both kidneys are known to be gravely affected with tuberculosis, and one of them is causing an active sepsis.

Nephrostomy Preliminary to Operation upon the Bladder.—In Watson's operation for drainage of the kidney preliminary to removal of the bladder, the surgeon's object is not to make a fistula that will soon close, but to make one that will remain permanently open.

> The only difference between the ordinary nephrotomy and the operation by which a permanent drainage of the kidney is arranged, consists in attaching the edges of the renal incision to those of the lumbar wound. This is done by placing a row of mattress sutures on either side of the incision . . . after which the kidney and lumbar incisions are brought together by another row of sutures, thus closing them around the drainage tube. The latter is at first held in place by a stitch passed through it and through the skin at the point at which the tube emerges from the surface. (Watson.)

Apparatus for Drainage.—Whenever nephrostomy is done, urine, or urine and pus, run from the wound in large quantities and often for a considerable time. It is, therefore, necessary to provide the patient with an apparatus that will dispose of this outflow while he is moving about.

A patient of mine is now wearing a silver tube, to which is attached a silver disk 3 inches in diameter, to rest against the skin, while the end of the tube is turned down at a right angle, and from it a short rubber tube leads into a leg urinal. For certain cases, the apparatus of Watson may be more convenient.

NEPHRECTOMY

Four kinds of nephrectomy require description: lumbar extracapsular nephrectomy, lumbar subcapsular nephrectomy, partial nephrectomy, and abdominal or intraperitoneal nephrectomy.

Lumbar Extracapsular Nephrectomy.—The kidney is cut down upon in the usual manner and brought up into the wound. The fascia is then peeled away with especial care from about the vessels and ureter, and the ureter itself is freed from the peritoneum, tied in two places with chromic catgut, and divided by the actual cautery between the two ligatures. The mucous membrane of the ureter is then thoroughly cauterized, dealing with it as one would with the appendix.

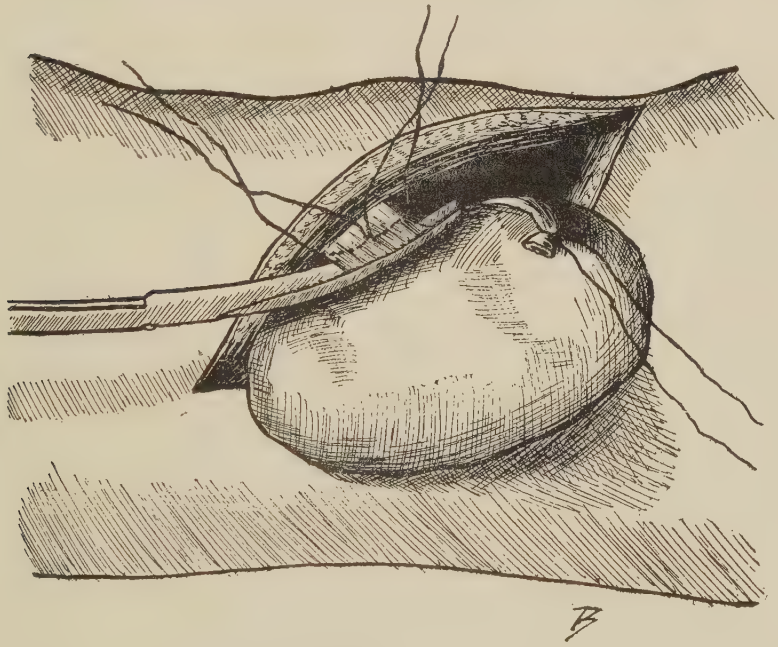

FIG. 161.—NEPHRECTOMY. (After Albarran.)

The vessels of the pedicle are then freed as much as possible from fascia and adhesions, and the pedicle clamped, care being taken to avoid, if possible, grasping the pelvis of the kidney in the clamp (Fig. 161). The kidney may then be removed; or, if it is not voluminous, left in place while the vessels of the pedicle are tied, individually or in two bunches, above the clamp. The kidney is then cut away from the clamp; or, if there is any question as to whether the pelvis has been caught by the clamp, this may be removed and the pedicle divided with the actual cautery, great care being taken not to burn off the ligatures. These

should then be reënforced, either by separate ligature of the individual vessels seen in the cut surface, or by a ligature of the whole pedicle above the ligatures first placed. If the kidney comes well out into the wound, one may perform these manipulations without the assistance of any clamp.

Disposition of the Ureter.—Unless the ureter is gravely infected or tuberculous, it may be abandoned in the wound after ligature and cauterization. But if inflamed it should be brought up to the lower end of the skin wound.

Variations in Operation.—Certain variations of the operation may be described. These are:

Variations in the incision.
Nephrectomy for tumor.
Nephro-ureterectomy.

Variations in the Incision.—If the kidney is densely adherent, the field of operation may be considerably enlarged by adding a transverse incision to the oblique one; or the surgeon may prefer to begin with the transverse incision and to add the oblique one in case of need.

Nephrectomy for Neoplasm.—Since neoplasms of the kidney extend both by the lymph nodes of the pedicle and into the fatty capsule, it is necessary, in operating upon a case of renal neoplasm, to employ a wide excision, and to remove the kidney, surrounded by its fatty and fascial capsule, and with as much as possible of the fascia about the pedicle. If any individual nodes are felt beyond this, these are enucleated after the nephrectomy has been performed.

Nephro-ureterectomy.—Not many years ago, when surgeons believed that, in order to cure renal tuberculosis, it was necessary to remove the ureter with the kidney, nephro-ureterectomy was frequently performed and the attempt was made to remove the ureter right down to the bladder; but this technic is no longer followed, and the only modern reason for nephro-ureterectomy is papillomatosis of the kidney and ureter, or a widely dilated or cystic ureter.

To perform this operation, the oblique lumbar incision is continued downward parallel with the iliac crest and with Poupart's ligament and about two fingers' breadth above these. The peritoneum is pushed back and the ureter, which is adherent to this, is readily freed to the brim of the pelvis. Within the pelvis the work of freeing the ureter is slower, but it is usually a matter of no great difficulty to liberate this duct down to where it enters the bladder; there it is tied and divided by the cautery.

Accidents during the Operation.—*The peritoneum may be torn* during the operation. This accident is unimportant, even though the kidney be septic. The peritoneal cavity is well filled with pads and the operation continued in the usual manner. At its termination, an attempt

may be made to close off the peritoneum, but, if this is impossible, it may be protected by packing.

Incision of the pleura is attended to in the manner already described (p. 837).

Tearing of the kidney itself, or of its pelvis, is an unfortunate complication, since it may render septic an operation that would otherwise be clean.

Inability to separate the kidney freely from its adhesions may leave a short, fibrous pedicle in which the vessels cannot be distinguished. This may be pierced with the aneurysm needle and tied off above and below; but, since it is possible to fritter away much time in vain attempts at clearing the pedicle, which may perhaps only result in tearing it and causing additional bleeding, it is often wiser, if the first attempt at freeing the pedicle fails, to clamp and divide it, and leave the clamp in place. The clamp should not be removed until the third or the fourth day.

I have seen hemorrhage from the pedicle entirely controlled by packing when the clamps had slipped unexpectedly, and Albarran has seen the same thing happen to another surgeon.

Tearing of the vena cava is an extremely grave accident, and one that is almost certain to cost the patient his life. Albarran recites the following methods of handling this accident, and the results of the procedures:

Packing (Lindner—cured); clamping (Socin and Israel—both died); lateral ligature (Luecke and Helferich—both died); suture (Billroth, Bousse, Grohe, Schede, Pousson—five deaths); intentional resection in order to remove a malignant neoplasm of the kidney (von Manteufel and Giordano—one death); total ligature (Bottini, Houzel, Heresco, Hartmann, Delauney, Kuester, and Lindner—five cures and two deaths).

It is to be noted that the operation which looks the most dangerous is the one that has been the most brilliantly successful. Indeed, Gosset and Lescene [1] have shown on dogs that ligature of the cava below the kidneys is absolutely innocuous. Ligature above the kidneys causes death by renal congestion.

As an aid to the removal of the kidney, we may note the *resection of the outer portion of the last rib.* This is done just as in the operation for empyema, great care, however, being taken to spare the pleura. I have never resected the rib, and Albarran states that, in several hundred kidney operations, he has only had to do this four or five times.

Postoperative Complications.—*Hemorrhage* may always be controlled by packing.

[1] *Tribune Med.*, 1904, p. 213.

Insufficiency of the opposite kidney should be prevented by hypodermoclysis and colon irrigations. If the opposite kidney is known to be surgically diseased, and secretes no urine, in spite of these measures, it should be cut down upon and drained before grave symptoms of uremia appear.

Albarran states that one should operate on the third day of *anuria*, even without symptoms, or on the first appearance of twitching during sleep, contortions of the pupil, or headache.

Urinary fistulæ sometimes follow the operation, the urine being discharged up the ureter from the bladder. Such discharges ultimately cease. *Purulent fistulæ* require secondary operations. These should be performed, if possible, behind the scar of the first operation, in order to spare the peritoneum.

Lumbar Subcapsular Nephrectomy.—When the kidney is densely adherent, one may intentionally or accidentally tear the fibrous capsule in the blunt dissection of the fatty capsule from the kidney. When this separation of the fibrous capsule is once begun, it may readily be carried all about the kidney, and the organ thus brought fairly well up into the wound; but the pedicle is always more adherent than in the case of extracapsular nephrectomy, and it is very difficult to separate the pedicle sufficiently to tie it off. It may, however, be clamped *en masse*, either with or without previous liberation of the ureter and pelvis. If the ureter has not been freed before the pedicle is clamped, the kidney is then cut away and the pedicle treated as follows:

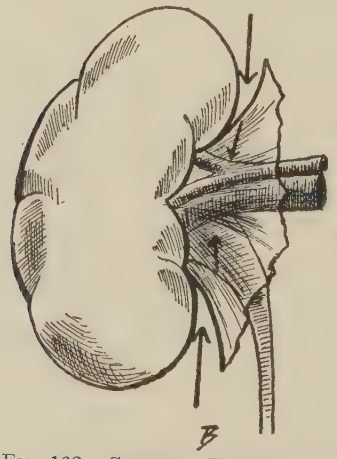

Fig. 162.—Showing How the True Pedicle is Obscured by the Fibrous Capsule in Subcapsular Nephrectomy. (After Albarran.)

A racket-shaped incision is carefully made about the vessels held by the clamp and extending downward over the probable course of the ureter. This incision is carried through the fibrous capsule of the kidney, but not into the adhesions about the vascular pedicle. The tail of the incision is first opened up and searched until the ureter is found. This is then picked up into the wound, divided and cauterized. Its upper extremity is then followed up and the the wound carefully enlarged until the pelvis can be made out. By this time one should be in a position to find the arteries, which are, accordingly, ligated doubly. If they cannot be ligated they are clamped; but it is preferable to put a new clamp above the point where the pelvis was caught, and to remove the pelvis and the upper portion of the ureter. Albarran advises the removal of the

whole fibrous capsule of the kidney as the terminal step of the operation, to prevent prolonged suppuration.

Nephrectomy by Morcellement.—When total subscapular nephrectomy is impossible, on account of adhesions, one may remove the kidney in sections. To begin with, the lower pole of the kidney is freed of its adhesions, clamped off by a long pedicle clamp, and cut away. The pedicle of the kidney is then identified, as well as possible, and a second clamp placed upon it. The remainder of the kidney is then rapidly cut away and the pedicle treated as in subcapsular nephrectomy.

LIGATURE OF THE RENAL PEDICLE

In case the difficulties of the operation are such as not to permit even nephrectomy by *morcellement,* or in case the kidney attacked has already been operated upon and great difficulties in its removal are foreseen, the safest operation to do is an interperitoneal section through a transverse incision to the outer side of the rectus. The colon is found and pulled inward, the posterior peritoneum palpated for the outline of the kidney, incised some 2 cm. or 3 cm. away from the gut, the renal vessels identified and tied off, after which the various peritoneal muscles and incisions are closed and no attempt made to interfere with the kidney. If this operation does not result in atrophy of the kidney and closure of the fistula, the kidney may then be attacked and extirpated wih relative safety.

Partial Nephrectomy.—Partial nephrectomy consists in removing a diseased portion of a kidney and leaving the healthy part.

The incision in the kidney tissue should be made in such a way as to permit accurate apposition of the wound surfaces. Thus, in removing a diseased portion of the horseshoe kidney, the incision through the connecting band should be V-shaped, so that it may be readily brought together.

Transperitoneal Nephrectomy.—Transperitoneal nephrectomy is practically restricted to the treatment of large neoplasms of the kidney. The incision should be vertical at the outer border of the rectus, and may be enlarged by a transverse incision running toward the loin. The posterior parietal peritoneum should be opened at least 3 cm. or 4 cm. from the colon so as to leave plenty of peritoneum to cover this at the end of the operation. The colon is, of course, thrown inward and the kidney separated much as usual. The kidney is removed with the perirenal fat, the pedicle tied off, the ureter cauterized, and then careful search made about the pedicle of the kidney for lymph nodes. These are carefully removed and the incisions in the peritoneum and parietes sutured. If drainage is required, tubes may be run through the peritoneal cavity into the pocket behind.

CHAPTER LXXXII

OPERATIONS UPON THE URETERS

INCISION OF THE PARIETES

The abdominal portion of the ureter may be reached extraperitoneally, either through the usual oblique lumbo-abdominal incision extended well forward, or through a vertical incision at the outer border of the rectus.

The lower pelvic portion of the ureter can be reached with difficulty through the ordinary lumbo-abdominal oblique incision. It is even less accessible by median section. The route usually employed is through a vertical incision at the outer side of the rectus below the umbilicus.

When the peritoneum is reached this is drawn toward the median line and carefully dissected free from the lateral pelvic wall, carrying the ureter with it. This duct is identified where it crosses the brim of the pelvis and followed down to its insertion into the bladder. If a stone is lodged near the bladder wall, this may sometimes be worked upward to a more accessible spot, where the ureter may be incised.

An incision which appears to give better and safer access to this portion of the duct has been recently devised by Gibson.[1] The skin and external oblique are incised in a broad curve (like the Pfannenstiel incision), beginning about 3 cm. above the anterior superior spine of the ilium and running parallel with Poupart's ligament to the median line. The aponeurosis flap is freely dissected upward and the aponeuroses of internal oblique and transversalis muscles divided in a vertical line at the outer border of the rectus. The peritoneum is then thrown inward and the ureter exposed as in the operation above described.

In the female, large stones caught just external to the bladder may be reached by incision in the vaginal vault; but if the stone is at all movable it is fixed in this position with great difficulty, and when the incision in the vaginal vault has been made the stone will be found to have slipped out of reach up the ureter. For small stones, therefore, even in the female, the abdominal route is preferable.

Stones caught in the intravesical portion of the ureter may some-

[1] *Trans. Am. Gen.-Urin. Assoc.*, 1909, vol. iv.

times be extracted by tapping them with the beak of the cystoscope or with the ureter catheter. Bransford Lewis has extracted stones by means of his ureter forceps. If these means fail, the stones may be reached by suprapubic cystotomy, the work on the ureter being done with counter pressure from the rectum. One need not fear to slit the orifice of the ureter widely.

Intravesical ureteral cysts may be opened in a similar manner.

VARIETIES OF OPERATION

Excluding the special operations for uretero-vaginal fistula, the operative surgery of the ureter may be considered under two heads: Plastic Operations and Extirpation.

Plastic Operations.

1. For kinks, valves, and strictures at junction of pelvis and ureter.
   - Ureterotomy.
   - Pyelo-ureterotresis (uretero-pyelo-neostomy).
   - Pyeloplication.
   - Nephropexy.

   (Any operation in the list below.)
2. For wounds, strictures, necrosis, disease or fistula entailing loss of continuity of the duct.
   - Uretero-ureteral anastomosis.
   - Cysto-ureterotresis (uretero-cysto-neostomy).
   - Closure of the ureter or nephrectomy.
3. For exstrophy of the bladder.
   - Cutaneous fistulization.
   - Entero-ureterotresis.
   - Maydl's operation.

Extirpation.

- Partial ureterectomy.
- Complete ureterectomy.

OPERATIONS FOR KINKS, VALVES, AND SIMPLE STRICTURES

These obstructions may be divided arbitrarily into two classes: Obstructions which may be relieved by operation upon the ureter only, and obstructions which cannot be relieved without operation upon the kidney or its pelvis.

Obstructions Remediable by Ureterotomy.—Such obstructions are commonly strictures, congenital or due to the presence of ureteral stone or disease of the ureter or of the adjacent viscera. These stric-

tures occur at the lower orifice of the ureter, where they cause intravesical ureteral cyst (the treatment of which is transvesical incision), or at or above the pelvic brim. Strictures in this latter location are reached after evacuation of the hydronephrosis by inguinal prolongation of the oblique lumbar incision.

Fig. 163. — Ureteroplasty or Pyelo-ureterotresis (after Morris). The stricture is incised longitudinally and two sutures are inserted.

A probe introduced into the ureter from the renal pelvis will at once detect the site of stricture (some surgeons prefer a preliminary ureteral catheterism for this purpose). The peritoneum is lifted forward and the ureter followed down until the strictured point is reached. It will here be found adherent to the peritoneum, which may be torn before the ureter can be freed. Such a tear should be immediately sutured. The ureter is then brought up into the wound and an attempt made to perform ureteroplasty on the principle of the Heinecke-Mikulicz operation for pyloric stenosis. The accompanying figures show the method by which a longitudinal incision is sutured transversely (Figs. 163, 164,

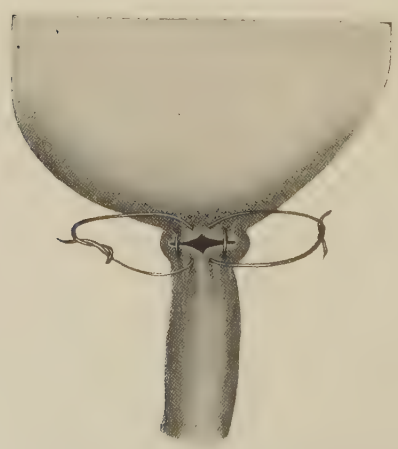

Fig. 164.—Ureteroplasty or Pyelo-ureterotresis (after Morris). The sutures are drawn so as to make the incision transverse.

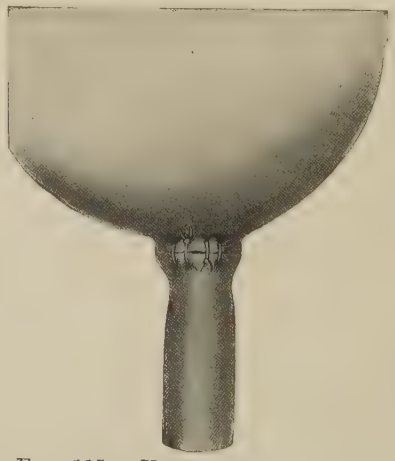

Fig. 165. — Ureteroplasty or Pyelo ureterotresis (after Morris). The result.

165). The sutures enter the lumen of the duct and must therefore be of catgut. They may be reënforced by suture of the peritoneal tissues.

If, for any reason, this operation cannot be performed: if the ureter cannot be freed, if it is accidentally torn across, if the stricture is too wide or the wall of the ureter above it too friable to permit the sutures to be satisfactorily applied, the ureter must be divided, resected, and some form of ureteral anastomosis employed.

Obstructions Requiring Operation upon the Pelvis or the Kidneys.—Such obstructions, usually due to nephroptosis, and often the cause of intermittent hydronephrosis, are relatively common. The obstruction is at or near the junction of ureter and pelvis, and usually consists of a kink closely surrounded by adhesions and perhaps associated with a valve or a stricture.

In attempting the operative relief of such an obstruction it is well to remember that the object of the operation is simply to insure a free outflow of urine. To this end kinks must be straightened, stenosis relieved, and the ureteral orifice placed at the most dependent point of the pelvis. In order to accomplish this threefold purpose the simplest operation—viz., reposition of the prolapsed kidney, after the liberation of adhesions—is usually all-sufficient. The pelvis having been emptied of its contents and adhesions having been freed as far as necessary, the internal ureteral orifice is palpated and inspected through the incision in the pelvis. If it is not constricted and a probe passes freely down the ureter, the kidney is replaced high up under the ribs, and it will probably be found that, with the organ in this position, the dilated pelvis falls into a funnel shape with the ureter leading directly from its apex. In such a case nephropexy is all that is required.

But conditions may be complicated in three ways:

1. *It may be Difficult to find the Orifice of the Ureter.*—The search may be facilitated if the hydronephrosis is large by everting the sac (Fenger) and subjecting its internal surface to a careful scrutiny, or by identifying the ureter below the constriction and pulling upon it in order to dimple its orifice, or by introducing a probe (through a longitudinal incision) upward along the ureter, or by ureteral catheterism.

2. *There may be Stricture of Valve.*—This may be relieved by ureteroplasty or by pyelo-ureterotresis (Figs. 163, 164, 165).

3. *The Pelvic Dilatation may have occurred irregularly, so that when the Kidney is replaced high up in the Loin there is still a Pouch hanging below the Ureteral Orifice, calculated to invite Infection of the Retained Urine and to lead to Renewed Nephrectasis.*—This condition is unusual, and its treatment depends upon whether or not it is associated with valve or stricture. When there is a simple pouching of the pelvis which cannot be remedied by nephropexy it may be obliterated by suturing the two walls of the pouch together (pyeloplication) after scari-

fication of the mucous membrane (Israel, Albarran). Albarran even went so far in one case as to resect the lower pole of the dilated kidney with the adjoining portion of the pelvis.

When ureteral stricture and pelvic pouching coexist the best operation is lateral anastomosis of the ureter with the pelvis (pyelo-ureterotresis). A longitudinal incision in the ureter below the stricture is sutured with fine catgut to a corresponding incision at the most dependent point of the pelvis. This operation has been performed unsuccessfully by Helferich, successfully by Delbet and Albarran.

Yet, in spite of the success that has attended almost every plastic operation proposed for the relief of renal retention, it is a suggestive fact that Tuffier has cured 17 consecutive cases by nephropexy. Certainly the great majority of hydronephroses were cured by these methods before the days of plastic ureteral surgery, and, while our wider knowledge of the subject makes it the surgeon's duty not to be satisfied until he has identified the source of obstruction, he may rest assured that fixation of the kidney in its proper place, freeing of adhesions, and removal of calculi—if any be present—will almost always suffice to relieve the obstruction and to prevent its recurrence.

URETERAL ANASTOMOSIS

Under this caption may be grouped all operations for the purpose of reëstablishing the flow of urine through a ureter divided by accident or design, together with an estimation of the obstacles to the success of such an operation and a consideration of the proper procedure to elect in case anastomosis is impossible. Thus we shall review the technic and merits of (1) anastomosis of the ureter with itself and with the bladder; (2) anastomosis with the intestine and cutaneous fistulization; (3) closure of the ureter and nephrectomy.

Uretero-ureteral Anastomosis.—Since the end-to-end anastomosis of the earlier operators is now generally condemned as predisposing to stricture, there remain but three operations to be considered—viz.:

1. End-in-end anastomosis.
2. Oblique end-to-end anastomosis.
3. Lateral anastomosis (end-in-side).

End-in-end Anastomosis.—This operation was first suggested by Poggi, and has been modified by Mayo Robson [1] and Gubaroff.[2] The upper end of the ureter is cut obliquely (to prevent stricture) and the lower end dilated (Poggi) (Fig. 166) or incised longitudinally (Robson). The upper end is then drawn into the lower by a single suture, as in Van Hook's operation, the longitudinal incision closed by Lembert sutures

[1] *Internat. Med. Ann.*, 1896, p. 602. [2] *Centralbl. f. Chir.*, 1901.

of fine silk, and the union strengthened, if the operator deems it necessary, by a circle of fine silk Lembert sutures around the external line of union.

Oblique End-to-end Anastomosis (Wesley Bovée).—Both ends are cut obliquely, dilated,[1] and sutured with rectangular and simple interrupted

FIG. 166.—END-IN-END ANASTOMOSIS (Poggi).

FIG. 167.—OBLIQUE END-TO-END ANASTOMOSIS (Bovée).

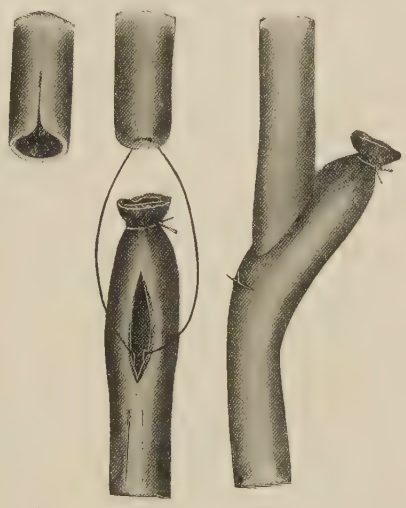

FIG. 168.—LATERAL ANASTOMOSIS (Van Hook).

sutures of silk traversing only the outer coats of the duct and reënforced by a few Lembert sutures (Fig. 167).

It is convenient in this, as in most of the other plastic operations upon the ureter, to suture the tube after the introduction (from the bladder) of a ureteral catheter, or, as Howard Kelly [2] has suggested, a guide introduced through a longitudinal incision in the wall of the duct.

Lateral Anastomosis (Van Hook).—To quote the author's lucid description:

a. Ligate the lower portion of the tube $\frac{1}{8}$ or $\frac{1}{4}$ inch from the free end. Make with fine sharp-pointed scissors a longitudinal incision twice as long as the diameter of the ureter in the wall of the lower end, $\frac{1}{4}$ inch below the ligature.

b. Make an incision with the scissors in the upper portion of the ureter, beginning at the open end of the duct and carrying it up $\frac{1}{4}$ inch. This incision insures the patency of the tube (Fig. 168, *A*).

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[1] It has been observed by various writers that the ureter could be dilated with ease to twice its normal size.

[2] *Jour. of the Am. Med. Assoc.*, 1900, xxxv, 860.

c. Pass two very small cambric needles armed with one thread of sterilized catgut through the wall of the upper end of the ureter $\frac{1}{8}$ inch from the extremity, from within outward, the needles being from $\frac{1}{16}$ to $\frac{1}{8}$ inch apart, and equidistant from the end of the duct. It will be seen that the loop of catgut between the needles firmly grasps the end of the ureter.

d. These needles are now carried through the slit in the side of the lower end of the ureter into and down the tube for $\frac{1}{2}$ inch, where they are pushed through the wall of the duct side by side (Fig. 168, *B*).

e. It will now be seen that the traction upon this catgut loop passing through the wall of the ureter will draw the upper fragment of the duct into the lower portion. This done, the ends of the loop are tied together securely, and, as the catgut will be absorbed in a few days, calculi do not form to obstruct the passage of urine (Fig. 168, *C*).

f. The ureter is now enveloped carefully with peritoneum. This may be done by lifting the duct gently into the cavity of the peritoneum, drawing down the serous membrane carefully behind the ureter, and after pulling the peritoneum around it, stitching it in a position to permanently inclose and protect the tube.[1]

Bache Emmet employs three sutures to drag the upper segment into the lower one. This for the pupose of puckering the upper segment, if it is considerably dilated (Fig. 169).

We may disregard the discussion of the relative methods of the three procedures, but the following observations seem apposite:

1. All of the operations have been equally successful.

2. Invagination, whether end-in-end or end-in-side, may be performed more easily and rapidly than Bovée's operation.

3. End-in-side anastomosis wastes more of the length of the duct than either of the other two. Bovée claims that his op-

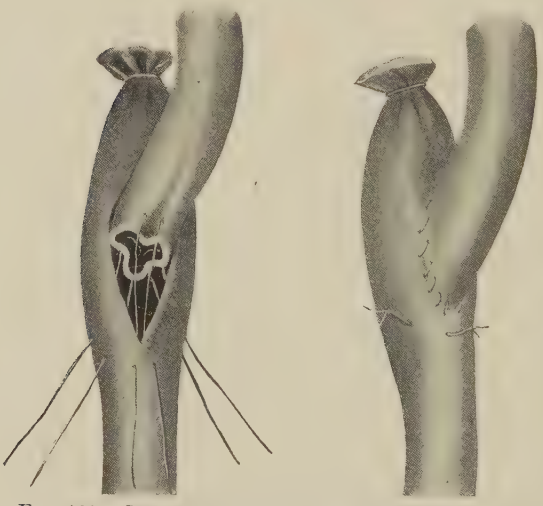

Fig. 169.—Lateral Anastomosis (Bache Emmet).

[1] Van Hook is here speaking of an intraperitoneal operation, which ureteral anastomosis almost always is. If, however, the duct has been approached from behind the peritoneum, the risk of opening that structure into a cavity over which urine of at least doubtful cleanliness has been poured would scarcely be compensated for by the advantage of a peritoneal investment.

eration may be performed even though as much as 3 inches of the duct have been cut away.[1] He has also suggested that in case of need the kidney may be loosened and stitched low in the loin.

4. Whatever method is employed it is customary to use catgut for all sutures that enter the lumen of the duct, and silk for the others; this in order to avoid calculous incrustation.

5. When the lower end of the ureter is lost or useless for any reason, cysto-ureterotresis is the operation of choice. When this is impracticable, the choice lies between entero-ureterotresis and nephrectomy (or shutting off the ureter with the object of causing atrophy of the kidney —a dangerous though simple procedure), with a preference for the latter, if the opposite kidney is able to support life.

Cysto-ureterotresis. — Cysto-ureterotresis (uretero-cysto-neostomy) has been employed usually for the relief of uretero-vaginal fistula, rarely for other conditions when ureteral anastomosis proved impracticable.

Poggi, in 1887, made the first experiments in reference to this operation. Novaro and Bazy were the first to perform it.

Three routes have been chosen—viz., vaginal, sacral, and abdominal. The vaginal and sacral routes have nothing to recommend them.

Almost every surgeon who has performed the abdominal operation has devised his own technic. The various methods have been enumerated by Boari [2] and Morris.[3] To avoid confusion, it is best to describe only a type operation. The peculiarities of each case will suggest the necessary modifications.

Whether the ureter is to be attached intraperitoneally or extraperitoneally is often decided by the features of the case. It is safer to operate extraperitoneally through the lumbo-inguinal incision when possible, elevating the peritoneum until the bladder (distended with boric-acid solution) is entirely exposed, freeing the ureter from the peritoneum and drawing it down.

The bladder is then emptied by catheter and incised on the point of a sound at the most convenient point. The ureteral orifice is then split to prevent stenosis, and attached to the bladder by means of a catgut traction suture (as in the Van Hook anastomosis). It is convenient at this juncture to introduce a ureteral catheter and upon it to suture the outer layers of ureter and bladder. When the operation is performed within the peritoneum the line of union should be protected by a peritoneal or an omental fold.

While the Boari button has twice been employed successfully, it has the obvious disadvantages of its prototype, the Murphy button—viz.,

[1] *Jour. of the Am. Med. Assoc.*, 1901, xxxvii, 254.
[2] *Guyon's Annales*, 1899, xvii, 1059, 1141.
[3] *Op. cit.*, ii, 563.

possibility of stricture and difficulty of extraction (it cannot be used in the male for this reason).

After operation it is customary to leave the ureteral catheter in place for four or five days.

In several instances the ureter has seemed too short. An inch or more may be gained by loosening the pubic attachments of the bladder (Witzel, Kelly, Penrose) and suturing its fundus to the lateral pelvic wall. Boari has succeeded experimentally in bridging a greater gap. He dissected up as a flap the whole thickness of the anterior bladder wall an inch wide with its base at the fundus. This he turned back and sutured as a sleeve about a ureteral catheter and the extremity of the ureter. He then closed the wound in the bladder. Such an extensive line of suture would require protection by drainage for fear of leakage. Dislocation of the kidney to gain slack has not been performed in connection with cysto-ureterotresis. An isolated loop of intestine has been employed experimentally to bridge the gap between ureter and bladder.

Results.—On the whole, the results obtained in plastic ureteral surgery are excellent. They preserve the healthy kidney and permit it to remain sound, and are not attended by any notable difficulty in technic nor any considerable mortality. In direct contrast are the operative methods employed to divert the course of the urine, which, by the difficulty of their technic, their high mortality, and small percentage of actual cures, may well deter the most experienced. In the table at the beginning of this chapter they have been listed "for exstrophy of the bladder" because this unfortunate deformity is almost the only warrant for their performance.

Closure of the Ureter and Nephrectomy.—When all attempts at reëstablishing the continuity of the ureter fail, nephrectomy may be contemplated as preferable to cutaneous fistulization or entero-ureterotresis. Indeed, if the opposite organ is known to be sound the removal of one kidney may be perfectly compatible with the maintenance of life. Under these circumstances the operation is quite free from danger.

In a few instances surgeons have been satisfied to tie off the ends of a divided ureter and so to leave the kidney to atrophy. As far as I know the result has always been happy; yet to leave the kidney thus as a possible focus for suppuration is no small risk, for numerous experiments have shown that with the ureter thus tied off the kidney falls a victim to bacteria which, under ordinary circumstances, it could transmit without harm to itself. Hence, of the two operations nephrectomy is to be preferred.

OPERATIONS TO DIVERT THE URINARY STREAM

Cutaneous Fistulization.—The operation of nephrostomy is preferable to ureteral cutaneous fistulization, which, as Watson justly re-

marks, either results in a kinking of the duct or brings the fistula too far forward to be conveniently handled.

Entero-ureterotresis. — The implantation of one or both ureters into the bowel (the rectum or the sigmoid flexure is usually selected) is followed, when successful, by results which, at first sight, are encouraging. The rectum becomes accustomed to retain the urine perfectly for a space of from three to six hours, and the immediate result is by that much better than cutaneous fistulization. This fact has led many surgeons to advocate the operation. But recent researches tend to prove that the conclusion was precipitate. Animal experiments from the time of Glück and Zoller (1881) down to Peterson,[1] Zeit,[2] and Frank [3] have been extremely discouraging. The immediate mortality runs from 60 per cent to 90 per cent, while those dogs that survive show interesting lesions.

Dogs which had fully recovered from the operation and the resulting pyelo-nephritis,[4] and were, to all appearances, in perfect health and vigor again, *all* had granular, contracted kidneys, due to induration and cicatrization of diseased areas. . . . Dogs which had fully recovered after unilateral implantation were living by the other kidney. The kidney of the side operated on was atrophic and granular, the result of an early pyelo-nephritis. The functionally active kidney was from 2 to 8 times the size of the atrophic one (Zeit).

The results of the operation upon man have been but little better. According to Peterson, double implantation has been performed 18 times with 8 deaths (44 per cent) immediately due to the operation, and 3 deaths from a subsequent pyelo-nephritis (total mortality 61 per cent). Unilateral implantation fared somewhat better, with 3 primary deaths among 15 cases and 2 secondary deaths. Of those followed for more than a month after operation Peterson has compiled the following table: [5]

1 ureter implanted, well after	6 months.
1 ureter implanted, well after	18 months.
1 ureter implanted, well after	2 years.
1 ureter implanted, well after	8 years.
2 ureters implanted, well after	5 weeks.
2 ureters implanted, well after	3½ months.
2 ureters implanted, well after	10 months.
2 ureters implanted, well after	1 year.
2 ureters implanted, well after	3½ years.

[1] *Jour. of the Am. Med. Ass'n*, 1901, xxxvi, 444, 506, 569, 632, 735.

[2] *N. Y. Med. Jour.*, 1901, lxxiii, 756, 839.

[3] *Jour. of the Am. Med. Ass'n*, 1901, xxxvi, 1466.

[4] Which seems always to occur.

[5] I have advisedly omitted the cases of Beck and Evans, since both have died of pyelo-nephritis, though reported well at the end, respectively, of 7 and 13 months.

It is obvious, then, that about 1 out of every 3 cases upon whom unilateral implantation is done may be expected to live (whether with an atrophied kidney or not, we need not decide), while 1 in 4 bilateral implantations should recover. The evidence is, I agree, ample to condemn either procedure, even without the strong probability that the survivors all have damaged kidneys.[1] But, fortunately, we have, in nephrostomy and in Maydl's operation, procedures which, while not by any means bereft of danger, afford a chance of recovery sufficient to bring them well within the scope of practical surgery.

Maydl's Operation.—In 1894 Maydl [2] reported his first cases of uretero-trigonal anastomosis. This operation consists of the implantation into the colon, not of the ureter itself, but of the bladder wall surrounding the mouth of the ureter. The operation has only been employed for exstrophy of the bladder and allied conditions, and is performed as follows: A probe or a ureteral catheter is introduced into each ureter after the operative field has been cleansed as well as may be, and an elliptical section surrounding the mouths of both ureters is then cut from the bladder wall, great care being taken not to injure the ureters. Next, the peritoneal cavity is opened. A convenient loop of the sigmoid flexure or the rectum is selected and brought out of the abdominal wound. The ureters, with their attached portion of trigone, are then freed, a longitudinal incision is made in the wall of the gut, with the necessary precautions, and into this the section of trigone is sutured. The remainder of the bladder is now stripped of its mucous membrane and the abdominal wound closed as tightly as possible, with splitting and transposition of the recti, if necessary. As a final precaution the sphincter ani is stretched and a tube inserted and left in for several days to establish drainage and so to minimize the danger of leakage and renal retention.

This operation avoids several of the dangers associated with simple uretero-intestinal anastomosis. For the cicatricial ureteral orifice, which has proved so liable to contracture with disastrous results to the kidney, it substitutes the normal muscular orifice of the ureter, and, while this is not an absolute protection, it has proved very effectual clinically. Among 36 cases collected by Peterson there was a primary mortality of 14 per cent (5 cases) and a secondary mortality of 5 per cent (2 cases). Sphincteric control proved good in 27 cases, fair in 4, and poor in 1. The convalescence of 6 cases was delayed by temporary urinary fistulæ. These figures proclaim the practical advantage of Maydl's operation. Yet even this procedure cannot be considered ideal. A capital operation in the course of which a foul bladder and the peri-

[1] *Jour. of the Am. Med. Ass'n*, 1901, xxxvi, 1263.

[2] *Wien. med. Wochenschr.*, 1894, xliv, 1113, 1169, 1209, 1256, 1297. *Ibid.*, 1896, xlvi, 1241, 1333, 1373. *Ibid.*, 1899, xlix, 249, 304, 360.

toneal cavity are simultaneously invaded must always retain an appreciable mortality, and diverting the urine from the bladder into the rectum can never be accepted except as a makeshift to avoid greater evils.

Peters's Operation.[1]—This modification of Maydl's procedure consists in dissecting out each ureter separately with its surrounding bit of trigone, and implanting each in a separate hole punctured in the anterior rectal wall immediately behind the wound made by freeing the ureters, the whole operation being extraperitoneal. The ureter ends hang free in the rectum. The ureter catheters are immediately withdrawn and the sphincter stretched to prevent back pressure.

URETERECTOMY

Ureterectomy has been repeatedly performed for tuberculosis, less often for neoplasm, stone, and stricture. In these last conditions ureterectomy is only indicated when it is deemed inadvisable or impossible to preserve the kidney. Indeed, the operation commonly passes by the name of nephro-ureterectomy, for, excluding the cases of resection already alluded to, excision of the ureter implies a previous or a simultaneous nephrectomy.

With the patient lying upon his side the oblique lumbo-ilio-inguinal incision is made (p. 835) and carried down as far as need be, even to the external abdominal ring. When the peritoneum is reached it is carefully elevated and the ureter sought for. If the operation is being performed with nephrectomy the ureter is usually readily traced down; but if the ureterectomy is secondary it is preferable to disregard the fistula and to search for the duct where it crosses the brim of the pelvis. The peritoneum is carefully elevated until the finger feels and recognizes by their pulsations the internal and external iliac arteries. Opposite the junction of these, closely confined to the peritoneum by its fibrous sheath, the ureter will be found. The sheath is nicked, an aneurysm needle passed under the ureter, and after that the dissection is easy unless there are adhesions, in which case great care must be exercised not to tear the peritoneum. The ureter may be followed down into the pelvis to its vesical orifice, where it is to be divided between ligatures. The external wound is then sutured in layers after such irrigation and with such drainage as the surgeon deems advisable.

Several surgeons have employed the combined abdominal (extraperitoneal) and vaginal method devised by Kelly, but it has not proved as satisfactory as the method described above.

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[1] *Brit. Med. Jour.*, 1901, June 22.

The excision of that part of the bladder wall adjoining the mouth of the ureter is difficult and unnecessary except in those rare cases of ureteral neoplasm which extend into the bladder. The operation is best performed by extraperitoneal abdominal section combined with suprapubic cystotomy, the wound in the bladder being sutured according to the usual method.

CHAPTER LXXXIII

ANATOMY OF THE BLADDER—SUPRAPUBIC OPERATIONS

ANATOMY

The bladder is a muscular sac lying, in the male, between the rectum and the pubes when empty, and distending, when full, into an oval bag occupying more or less of the hypogastrium (Fig. 25). Its position is fixed below by the urethra, by the pelvic fascia, which, after lining the cavity of the true pelvis, is reflected upward and lost on the bladder and rectum (as pubo-prostatic and inferior vesical ligaments), and by the recto-vesical fascia, which binds the prostate and the neck of the bladder to the rectum. The muscular tissue of the organ is covered on the outside by peritoneum, on the inside by mucous membrane. Above and on the sides the peritoneum covers the bladder, but is attached loosely, especially at the base, so as to offer no obstacle to any change in shape or position of the viscus.

A knowledge of the peritoneal reflections upon the bladder is essential to a correct understanding of the operations of epicystotomy and suprapubic aspiration. When the bladder is empty it lies contracted behind the pubes; the peritoneum leaves the abdominal walls at the symphysis, and passes at once to the bladder, over which it is spread, and thence reflected upon the rectum from the base of the bladder, so that, when the latter is absolutely or even partially empty no trocar or aspirating needle may reach it from the anterior abdominal wall without traversing the peritoneal cavity.

Very different, however, is the condition of the viscus when distended. Then, as its cavity fills up, the peritoneum is carried with it. In this way the distended bladder carries up the peritoneum in front, so that in extreme retention a distance of 2 to 5 cm., or even more, above the symphysis becomes bare of peritoneum. Hence the election of the region immediately above the pubes for aspiration and the necessity of filling the bladder before attempting suprapubic cystotomy. The relation of the peritoneum to the bladder also varies behind. When the viscus is distended the peritoneum barely reaches the blind ends of the seminal vesicles; when empty it descends between them almost to the prostate.

The *shape* of the bladder varies with age. The bladder of an infant is ovoidal in shape, with its long axis running downward and a little forward, and its apex at the urethral orifice. It lies, when full, almost entirely out of the pelvis. As age advances the bladder sinks into the pelvis, assumes an almost spherical shape when filled and possesses a flattened floor in the region of the trigone. Later still the *bas fond* appears with its attendant ills.

The *muscle* of the bladder is composed of three coats—external, middle, and internal. The external or longitudinal coat consists of numerous fibers running from the prostate up over the fundus, where they are met by a similar set of fibers from the anterior surface. On the place of meeting there is often a swirl or "cowlick" of muscle fibers. Over the sides of the organ the longitudinal layer is thin and unimportant. Its fibers are closely connected with the prostate and the deep layer of the recto-vesical fascia, and intermingle with the deeper layers of the bladder muscle. The middle layer forms the bulk of the vesical muscle. Its fibers are densely interlaced and have a generally circular character. The internal layer of muscle consists of a few scattering bundles of longitudinal fibers, so irregular and inconspicuous that some anatomists deny their existence.

The *trigone* of the bladder is part of the urethra (p. 39).

The *mucous membrane* of the bladder is of a pale salmon color, remarkably insensitive in health, covered by a stratified pavement epithelium, and lying in folds when the bladder is contracted, except over the trigone, where it is always smooth. The glands are not numerous, except on the trigone and near the neck. They are exceedingly small, and composed of clusters of simple follicles. The coats of the bladder are united by connective tissue, which is everywhere loose, except at the trigone.

The bladder is arbitrarily described as having four sides—anterior, posterior, and two lateral. These four sides meet above in the *fundus,* below and in front in the *neck,* which is the urethral orifice. The trigone and surrounding portions of the posterior wall are spoken of as the *floor.* The ureters pierce the floor of the bladder obliquely and open at the angles of the trigone.

The *arteries* of the bladder are the superior, middle, and inferior vesical. They anastomose freely. The *veins* are numerous and lie in three planes—the subserous, the intermuscular, and the submucous. They anastomose freely with one another and with the prostatic plexus, and the plexus of Santorini above the neck of the bladder. They empty into the hypogastric veins. The *lymphatics* of the bladder wall were overlooked by the older anatomists, but their existence has been repeatedly verified of late years. They run chiefly beneath the mucous membrane and empty into several small groups of glands lying about the

bladder itself and thence into the iliac glands along the internal and common iliac vessels. These iliac glands are commonly infected by vesical neoplasms. The lumbar glands are less frequently involved, the inguinal glands very rarely (Pasteau [1]).

The fetal bladder is connected with the allantois by the *urachus,* and this canal, closing at the time of birth, persists as a fibrous, subperitoneal cord connecting the fundus of the bladder with the umbilicus. This canal very exceptionally remains patent throughout the whole or a part of its length.

SUPRAPUBIC OPERATIONS UPON THE BLADDER

The following are the types of operations performed upon the bladder by the suprapubic route:

Puncture of the bladder.
Aspiration of the bladder.
Median suprapubic section.
Transverse suprapubic section.
Suprapubic section with resection of the pubes, or symphyseotomy.
Suprapubic lithotomy.
Intraperitoneal cystotomy.
Suprapubic section for tumor.
    Removal of pedunculated growths.
    Partial cystectomy.
    Urétero-cystoneostomy.
    Complete cystectomy.
Suprapubic cystostomy.
Excision of vesical diverticulæ.
Curettage of the bladder.
Suprapubic prostatectomy.

Puncture of the Bladder

In preantiseptic days puncture of the distended bladder gave such bad results that it was abandoned in favor of aspiration. Puncture of the bladder may, however, be safely employed if a few simple precautions are attended to. The advantage of the operation is that it may be done very rapidly under local anesthesia. It is required only when the bladder is distended with urine.

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[1] "État du système lymphatique dans les maladies de la vessie et de la prostate," Paris, 1898, p. 48.

Special Instruments Required.—Trocar and cannula of such size that a 15 French soft-rubber catheter will pass snugly through the cannula. The catheter should have two eyes and should be of soft rubber.

Technic.—The hypogastrium is shaved and prepared as for a major operation. Before beginning the operation, the surgeon assures himself by percussion that the bladder underlies the abdominal wall, and that no intestines intervene. The skin is then infiltrated in the median line for a distance of 2 cm., beginning 1 cm. above the pubes. The infiltrated skin is incised and drawn apart by two artery clamps. The subcutaneous tissue and the fascia of the linea alba are then incised. This may usually be done without any further infiltration. The trocar and cannula are then introduced through the incision and plunged into the bladder, the trocar withdrawn and the urine permitted to flow out, the cannula being depressed a little as the bladder empties itself. The soft-rubber catheter is then introduced through the cannula into the bladder and the cannula withdrawn. The catheter should project at least 3 cm. into the cavity of the bladder. It is then caught to the muscles or the skin by means of a suture, a cigarette drain introduced alongside it down to the bladder wall, and the skin partially sutured.

After-treatment.—The cigarette drain is withdrawn in forty-eight hours, the wound protected by antiseptic dressings until it heals, the bladder irrigated through the catheter every day, and the catheter attached to an appropriate receptacle to catch the urine. The patient need not be confined to bed after operation.

Postoperative Complications.—The one danger is infection of the cellular tissue between the bladder and the abdominal wall. If this occurs, the wound must be enlarged and the infected space drained.

Aspiration of the Bladder

The hypogastrium is prepared antiseptically and the bladder percussed as for puncture. An aspirating needle 4 cm. long should be used. This is plunged directly into the bladder at a point about 1 cm. above the pubes. The urine is aspirated and suction continued as the needle is withdrawn.

The danger of infection along the track of the needle is slight; if it occurs, it calls for incision and drainage.

Suprapubic Cystotomy

Special Instruments Required.—Besides the ordinary scalpels, forceps, clamps, *et cetera,* a strand of heavy silk should be at hand, long enough to make two loops for suspension of the bladder wall. No special retractors are absolutely necessary, and the mechanical retrac-

tors are not generally employed. Walker's suprapubic retractors are serviceable and may be employed instead of the silk ligatures.

Preparation of the Patient.—The pubes and genitals are shaved and prepared as for a major operation. A soap poultice should not be left on the scrotum more than three hours. If a catheter can be introduced into the bladder, this organ should be washed with 1 : 10,000 nitrate-of-silver solution once a day for several days before the operation, if there is infection and if the emergency permits. The patient should be put upon a table that will permit of the Trendelenburg position, but the operation is begun with the patient lying flat.

Distention of the Bladder.—The bladder is distended either with boric-acid solution or air. The latter is preferable, both because it lifts the bladder into the wound and because it does not soil the field when the bladder is opened. It is introduced through a catheter in the urethra, either by a piston syringe or by the bulb of a Paquelin cautery. The bladder is only moderately distended before the incision is made.

The Incision.—An incision is made in the linea alba at least 6 cm. in length, beginning 1 cm. above the pubes.

After getting fairly through the muscles, a thin fascia is observed with yellow fat beneath it. This fascia is divided transversely, then the pulp of the finger is placed between the yellow layer of fat and the symphysis, and the fat is rolled upward toward the upper angle of the incision. This layer of yellow fat contains the peritoneum, which is not seen unless adherent, in which case it may be torn into.

Tearing the peritoneum is not an important accident. The wound is quickly sutured with fine catgut and kept out of the way in the upper angle of the incision during the remainder of the operation.

The bladder is now pumped full of air until it fills the bottom of the wound, a tense globe covered with distended veins. With short-curved needles in a holder, a portion of the bladder is taken up in a broad loop on each side, the silk knotted in long loops, and these are used as retractors. Even though the veins be large they may be disregarded and the bladder boldly cut into between the ligature loops.

Incision of the Bladder.—A sharp-pointed bistoury is plunged directly down into the cavity of the bladder in the median line at the lower angle of the wound, and drawn rapidly upward and outward, incising the bladder wall sufficiently to admit the finger, or to a greater extent if that is required. The patient is then elevated into the Trendelenburg position, the bladder wound pulled open by the sutures, clamps, or special retractors, and the interior of the bladder palpated or inspected. Inspection is facilitated by the use of a head mirror or the electric head lamp.

After whatever intravesical operation is required has been performed, the bladder is sutured.

Suture of the Bladder without Drainage.—If the bladder is uninfected, it may be sutured without drainage, and, even if infected, careful suturing may succeed in closing its cavity. No suture should be employed for the mucous membrane. The wall of the organ may be best closed by introducing mattress sutures of 10-day chromic gut through the whole muscular coat down to the mucous membrane, and protecting these by one or two rows of Lembert sutures. The line of sutures should then be tested by filling the bladder through the urethral catheter.

The bladder is then anchored to the recti muscles by a suture at each side of the incision. This eliminates dead spaces.

In closing the abdominal wound, it is safer to leave a cigarette drain running down to the bladder, not only because of possible leakage after the operation, but because the wound may have been infected by the contents of the bladder during the operation. If the patient's urethra is tolerant, it is preferable to leave an indwelling catheter in place for at least three days, though this is often safely dispensed with.

Suture of the Bladder with Drainage.—If the bladder is infected, it is always safer to leave a suprapubic drain running into its cavity. If no intravesical hemorrhage is anticipated (as in suprapubic lithotomy), the drainage need only consist of two soft-rubber catheters. I prefer those devised by Tilden Brown, having a right angle, so that the catheters lie along the abdominal wall without kinking. They should be held in place by sutures. If considerable intravesical hemorrhage is anticipated (as in prostatectomy), a very large drainage-tube should be employed. The Freyer tube, whose lumen is large enough to admit the little finger, is the best. A soft-rubber catheter should be run alongside it for continuous irrigation. The bladder wound is sutured around this tube in the manner already described (Fig. 170).

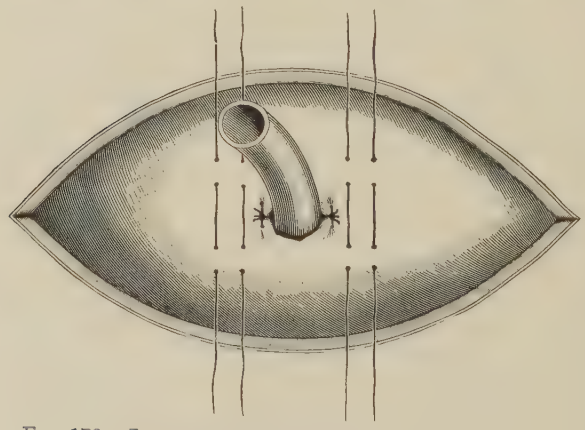


Fig. 170.—Inversion of Bladder Wall about Tube. (Gibson's method.)

After-treatment.—Continuous irrigation is kept up for several hours after all bleeding has ceased. The tube is left in place at least until the fourth or fifth day. On removal of the suprapubic tube, it is better to

insert an indwelling catheter into the urethra, whereby the urine is drawn off until the suprapubic fistula shall be sealed. If this cannot be done, urine flows from the fistula for a few hours, if the tube has been a small one, and for several days if the Freyer tube has been used. As the suprapubic fistula begins to close, this flow becomes intermittent and the patient urinates in greater and greater quantities, until, at the end of several days more, the wound has healed. The suprapubic fistula may remain open as long as several weeks.

Postoperative Complications.—If the patient's condition is bad at the time of operation, or if the suprapubic drainage works badly, so that there is leakage alongside the tube, the prevesical fat is likely to become infected and to slough away. This complication very much prolongs the healing of the wound; it should be irrigated frequently and the sloughs cut away as rapidly as possible.

Permanent fistula is unlikely to result after suprapubic section if there is no obstruction to the outflow of the urine through the urethra; but if such an obstruction exists it must be removed before the fistula will heal. If the patient is in poor physical condition, the fistula may break open several times before it finally heals. Its ultimate healing is hastened by keeping a tube in the outer portion of the wound, in order to make the bottom heal first, enlarging the wound for this purpose, if necessary; or, if the fistula has come down to a pin point, it may be cauterized with silver nitrate or by injections of alcohol or two or three drops of ethereal peroxid of hydrogen. This substance should be used with great care lest any of it get into the bladder and cauterize its mucous membrane.

Transverse Suprapubic Cystotomy

Incision.—The skin and the fascia over the rectus muscles are divided by a crescentic incision, the concave of which reaches to within 2 cm. of the border of the pubes, and the ends of which turn upward and extend to the edges of the rectus muscles. A transverse incision is then made through the median half of the two recti, but before dividing their outer portions they are caught by stout silk sutures. The remainder of the recti are then divided and the patient put into the Trendelenburg position. The fascia and fat overlying the bladder are then pushed upward and the bladder exposed, and this organ incised transversely to the desired extent. The edges of the bladder incision are affixed to the skin by sutures, or held up by clamps or retractors.

The Suture.—After the operation has been completed, the patient is let down from the Trendelenburg position, and the bladder sutured with or without drainage in the manner already described. The upper section of the recti is then pulled down by the suture loops that were placed at the beginning of the operation, and the muscles, with their anterior

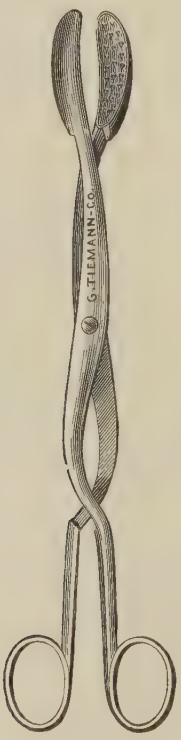
layer of fascia, united by mattress suture, after which the skin is sutured.

Resection of the Pubes and Symphyseotomy

Albarran [1] describes three methods of resecting the pubes and one of symphyseotomy. These procedures are employed for the purpose of total excision of the bladder, but this operation, if it is feasible at all, can be done without dividing the bones.

Suprapubic Lithotomy

The removal of stones through the suprapubic incision is accomplished by means of the lithotomy forceps (Fig. 171), which may be introduced under the guidance of the finger. The median incision is employed and the bladder is opened only far enough to admit the finger



A

B

Fig. 171.—*A*. Lithotomy Forceps. *B*. Scoop.

[1] "Médecine Opératoire des Voies Urinaires," Paris, 1909, p. 594.

and the instrument. After all stones have been removed, the bladder is very carefully palpated for diverticulæ which might contain small concretions.

Intraperitoneal Cystotomy (Harrington's Operation)

The Incision.—The incision is quite the same as that for extraperitoneal median suprapubic cystotomy, except that the incision of the abdominal wall should be extended to reach the umbilicus, and the peritoneum should be opened in the median line as in abdominal section. With the patient in the Trendelenburg position, the peritoneal incision is carried down to the reflection over the bladder, and that organ, distended with air, is then incised in the median line.

Suture of the Wound.—The bladder wound is closed with mattress sutures of chromic gut and protected by an additional line of Lembert sutures, including the peritoneum and the superficial layers of muscle. Although, according to Harrington (who was the first to employ this operation intentionally) and Mayo, it is unnecessary to drain by suprapubic tube, it is so impossible to be absolutely sure in all cases that no leakage will occur, that suprapubic extraperitoneal drainage for four or five days is surely a safeguard, and, if small tubes are used, need not prolong nor interfere with the convalescence. The line of suture should, of course, be tested very carefully by inflation of the bladder, and if the suprapubic tube is not used an indwelling catheter should be employed.

Suprapubic Section for Tumor

The operations required for the removal of tumor of the bladder, apart from the intravesical operations (p. 906), depend upon the nature of the tumor. We shall, accordingly, describe:

Removal of pediculated growths.
Removal of sessile growths of the anterior or lateral walls of the bladder (partial cystectomy).
Removal of sessile growths involving the trigone or the ureter (uretero-cystoneostomy).
Removal of the whole bladder (total cystectomy).

Removal of Pediculated Growths.—Special Instruments Required.—It is convenient to have a pair of Guyon tumor forceps with which to grasp the tumor, and it is sometimes necessary to have very sharply curved needles for suturing the mucous membrane at the bottom of the deep cavity. The Paquelin cautery should also be at hand.

The Incision.—If the growth is situated away from the bladder neck, it may be reached by the ordinary median incision; if near the bladder neck, the transverse incision may be required, or the median in-

cision may be somewhat enlarged by nicking the border of the rectus muscle at the lower end of the incision.

Suture of the Bladder to the Skin.—In order to prevent inoculation of the wound with fragments detached from the tumor the bladder wound should be sutured to the skin before the tumor is even touched.

Examination of the Bladder.—Although bladder tumors can be much better seen by the cystoscope than by the eye, after the bladder has been opened it is, nevertheless, essential to search the bladder cavity carefully on the chance of finding some tumor that has been overlooked by the cystoscope.

Removal of the Tumor.—The pedicle of the tumor is seized with the Guyon clamp as far as possible from the tumor itself and drawn upward into the wound. As it is drawn forcibly upward, the pedicle is transfixed at a distance of 1 cm. to 2 cm. from the clamp with catgut sutures, at intervals of about $\frac{1}{2}$ cm. The tumor is then excised with the mucous membrane for 1 cm. around the base of the pedicle. The sutures that had been previously placed are then tied, and, if any hemorrhage persists, are reënforced by further sutures. After removal of all tumors the bladder is once again carefully inspected before being closed.

Operative Complications.—If the tumor is large and bleeds freely, it should first be curetted away with the finger and its base then seized with the clamp, as soon as this can be seen. If the neoplasm tears away when grasped with the clamp, its base may again be caught, or, if this is impossible, the point of implantation should be thoroughly cauterized with the Paquelin cautery. If the tumor involves the edge of the ureteral orifice it may, nevertheless, be cut away; but in placing the sutures one should be careful not to compress the ureter.

Partial Cystectomy.—In order to remove tumors that are sessile, or that infiltrate the bladder wall, it is necessary to excise with them the whole thickness of the underlying bladder wall and the surrounding tissues for at least 2 cm. on every side of the growth. Partial cystectomy can always be done from without inward if the tumor is situated on the side or apex of the bladder. If upon the trigone, it must be performed from within outward. If, from the preliminary cystoscopy, it is inferred that more than one third of the bladder will have to be removed, or that there is infiltration of the whole trigone or even of the greater part of it, it is probably better either to attempt no excision at all or to attempt total cystectomy.

Resection from Without Inward.—A large incision will be required, but, inasmuch as there may be some difficulty in accurately approximating the bladder incision, it is preferable to make this extraperitoneal, if the peritoneum can possibly be stripped back far enough from the walls of the bladder. Otherwise, one operates intraperitoneally per-

force. The bladder is first opened in the median line. The tumor is then located by palpation and inspection, and is removed *en masse* with the surrounding bladder wall for 2 cm. away from its base. The bladder wall is closed as usual by mattress and Lembert sutures. If the tumor is low down near the ureter, this duct should be identified and isolated before the excision is performed, lest the ureter be accidentally divided.

Excision from Within Outward.—The incision is begun, if possible, at its deepest angle and carried straight through the bladder wall to the fatty tissue beneath. As the angle of the bladder is loosened it is grasped by volsella and pulled upward in such a way as to pull upon the vessels to diminish hemorrhage, and also to bring the wound closer into view and to make the remaining incision easier. After the tumor, with its surrounding bladder wall, has been excised, great care must be taken to place sutures through and through, including the muscle wall and the mucous membrane. Inasmuch as these have to be knotted inside the bladder, they should be of plain catgut.

Hemorrhage during the Operation.—Apart from the great difficulties in actually removing the tumor, the great complication of this operation is hemorrhage. Hemorrhage of the bladder wall itself is controlled by suture; hemorrhage of the vesical plexus of veins may require gauze packing to be left in place for forty-eight hours after the operation.

Resection the of Bladder with Uretero-cystoneostomy.—The bladder is opened in the usual manner and its interior inspected. If the tumor is found invading the ureter orifice and extending upward well on to the side of the bladder, it is removed from without inward. If it is confined to the region of the ureter orifice, it is removed from within outward.

Preliminary Ureteral Catheterism.—The subsequent steps of the operation are much facilitated if a catheter is now placed in the ureter and retained therein until that canal is divided.

Removal from Without Inward.—After placing the ureter catheter, the lateral bladder wall is seized with the fingers or with forceps, and the peritoneum stripped away from it until the ureter is reached. A strand of catgut is then passed around this tube and tied close to the bladder wall, the ureter catheter being withdrawn. Next, the tumor and the surrounding bladder wall are excised and the ureter divided. The bladder incision is then closed in the usual manner and the ureter implanted in the bladder wall, preferably at one side of the incision, but if necessary in the incision itself. The technic of this implantation is described elsewhere (p. 859).

Total Cystectomy.—Total cystectomy has given, in the past, almost 100 per cent mortality, either from the operation itself or from recurrence. Albarran mentions but one survival of five years (Hogge),

and one of fourteen years (Pawlick). The operation itself is extremely tedious and difficult. It is performed upon a patient whose vitality has been greatly reduced by the malignant neoplasm, and convalescence from the operation is complicated by the difficulties arising from the disposal of the ureters. It has been suggested that these be placed in the rectum or the intestine, in the vagina or the urethra, or in the superficial wound. All of these procedures have resulted thoroughly badly. The only operation that offers any hope is that suggested by Watson—viz., double simultaneous preliminary nephrostomy, followed, after an interval of a few days, by total cystectomy. The best technic for total cystectomy is probably that suggested by Albarran. It consists of the following steps:

In the Male.—Bilateral perineal incision and liberation of the posterior surface of the prostate, then of the lateral surface of the prostate, followed by division of the membranous urethra at the apex of the prostate, and liberation of the anterior surface of the prostate with cauterization of the cut ends of the urethra (p. 898). The patient, who has been in the lithotomy position, is then placed in the Trendelenburg position for the following steps:

Transverse incision of the skin and rectus muscles.
Separation of the peritoneum from the bladder.
Division of the pubo-vesical ligaments between two clamps.
Division of the ureters and of the lateral vascular connections of the bladder between clamps.
Cauterization and ligation of the cut ends of the ureter.
Removal of the bladder and prostate.

In the Female.—The perineal liberation of the bladder is replaced by incision of the anterior vaginal wall up to the cul-de-sac, and liberation laterally of the bladder from the surrounding tissues. The remainder of the operation is performed as in the male.

Suprapubic Cystostomy

Permanent suprapubic drainage of the bladder is performed by median suprapubic cystotomy, followed by suture of the wound in the bladder to the wound in the skin. Wassilief has suggested that a sphincter of some tone may be obtained by separating the mucous membrane from the muscle of the bladder wall, and, while leaving the muscle inside the abdominal cavity, drawing only the mucous membrane up to the skin.

Postoperative Treatment.—The drainage-tube is retained in place until the wound has healed. It is then removed and the patient protected by a hypogastric urinal (Fig. 114) or tube (Fig. 72).

Excision of Vesical Diverticulæ

The excision of a vesical diverticulum is required only when the suppuration occurring in this cavity keeps up so severe a cystitis as seriously to impair the patient's health. The operation is a difficult one. It consists in catching the side or the bottom of the diverticulum with a clamp, excising the mucous membrane of the cavity, and suturing the muscular wall in order to obliterate the cavity, and covering the whole with a suture for the mucous membrane of fine catgut. If possible, a drain should be carried down to the point of operation on the outside of the bladder, and the bladder itself should, of course, be drained.

Curettage of the Bladder

This operation is only performed upon seriously inflamed bladders, which are often so contracted that access to the cavity is attained with difficulty. The usual median incision is made, and when the bladder has been opened its mucous membrane is vigorously curetted away. On account of the irregularities of the surface, it is very difficult to remove all shreds of mucous membrane, and the remaining shreds may best be gotten rid of by cauterization.

Suprapubic Prostatectomy

The technic for suprapubic prostatectomy most popular to-day is that of Freyer, a modification of the procedure of Fuller, which in turn is a modification of the McGill operation.

The bladder is opened by a median incision and the finger introduced to make a rapid palpation of its interior. Stones, if present, are removed, and then the operator introduces one or two fingers of his left hand into the rectum to make counter-pressure upon the prostate; and, upon the organ thus pressed up into the wound, he palpates with the index finger of the right hand in the bladder. A rapid survey having satisfied him as to the shape of the enlargement, the prostatic capsule is opened in the median line. The easiest way to do this is with the serrated scissors of Fuller, one blade being introduced into the urethra, the other into the bladder. A deep cut is thus made in the median bar or lobe, and the index finger is immediately introduced into this. The finger is insinuated into the tissues until upon one side is felt the lobulated tissue of the hypertrophied gland, and upon the other the capsule. In this layer enucleation is rapidly made with the aid of counter-pressure from the rectum.

Freyer's technic consists in sweeping around the outside of the whole of the hypertrophied portions of the gland, between the gland tissue and

the capsule,[1] thus tearing away with the hypertrophied gland the whole of the prostatic urethra. The dissection is carried forward until the anterior limit of the enlargement is reached; then the whole prostate and posterior urethra are cut or torn away. Other operators do not insist upon removing the prostatic urethra, and it is not apparent that anything is gained by this procedure. One does as well by enucleating all hypertrophied portions of the gland, with the knowledge that in this enucleation a great part of the prostatic urethra will certainly be sacrificed; but if the gland is enormously enlarged, it is better to follow Freyer's technic precisely and remove the whole affair *en masse*.

After-treatment.—If one has been careful to keep in the right layer, and to remove only the hypertrophied lobes without tearing into the outer layers of the capsule of the prostate, the hemorrhage, though considerable at first, rapidly abates. The large Freyer drainage-tube should be introduced, with a small catheter alongside it, and continuous irrigation kept up through this. If the tube becomes plugged with clots it is disconnected, the clots are readily sucked out, and the continuous irrigation is resumed. Hypodermoclysis should be performed as a routine measure at least once after the operation.

Complications during the Operation.—If the fibrous sheath of the prostate is torn through during the operation, grave hemorrhage and later infection of the ischiorectal space are possible complications. To avoid these, drainage should be provided by rapid perineal section.

The patient is put in the lithotomy position, the skin and superficial tissues incised, a finger introduced into the prostatic capsule, or through the hole in this, from above, and another introduced through the perineal wound from below. By blunt dissection, keeping well forward toward the pubes, these fingers may be made to meet. A perineal drainage-tube is then introduced through this incision. Except under these circumstances, there seems no reason to apply perineal drainage to cases of suprapubic prostatectomy.

The only other operative complication worthy of comment is the difficulty that may be experienced in enucleating the gland. If the hypertrophy is small and the tissue fibrous and adherent, it may be impossible to enucleate with the finger without unduly lacerating the prostatic capsule. Under these circumstances, it is my custom either to excise a V-shaped piece from the prostatic bar, or to burn out that region thoroughly with the actual cautery. These fibrous prostates are the ideal cases for operation by the Chetwood method.

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[1] He originally insisted that he removed all the gland tissue; but this was mistaken phraseology.

CHAPTER LXXXIV

MEDIAN PERINEAL SECTION

The general types of median perineal section are the following:

Median perineal urethrotomy—

For drainage.
For drainage of prostatic abscess.
For drainage of periurethral abscess and infiltration.
For stricture (combined with internal urethrotomy).
For impassable stricture.
For prostatectomy.

PERINEAL SECTION FOR DRAINAGE

Position of the Patient.—The patient is placed in the so-called lithotomy position, upon his back, with thighs and knees flexed at an acute angle and held in this position by the Clover's crutch, leg supports, or the hands of two assistants.

Field of Operation.—The field of operation to be prepared antiseptically includes the pubes, the external genitals, the perineum, and the adjoining portions of the thighs and buttocks. These are prepared by the usual routine of shaving, soap poultice, and antiseptic dressing, and final scrubbing up upon the table. It is to be remembered that the sensitive skin of the scrotum is greatly irritated by the soap poultice, which cannot, therefore, be left in place for more than three hours. In scrubbing the patient upon the table, special care should be taken to clean the preputial cavity and to cleanse the bladder and urethra, if this is possible, by means of irrigation with nitrate of silver (1:10,000) or permanganate of potash (1:6,000). It is better to leave some of the fluid in the bladder, in order that this antiseptic may run out from the wound during the operation.

Instruments Required.—A grooved urethral staff, a sharp-pointed, curved bistoury, and a perineal tube. The perineal tube may consist of a soft-rubber tube with terminal and lateral eyes, to the tip of which is sewed the top of a soft-rubber catheter. The drainage-tube should be size 28 or 30 French, the catheter 15 or 16 French. In place

of this apparatus a metallic double-current tube with small inflow and large outflow may be employed. Of these there are several varieties. I use the one devised by Dr. Hagner of Washington.

Fig. 172.—Perineal Tube with Terminal and Lateral Eyes.

Instruments Employed if Local Anesthesia is Used.—The urethra is anesthetized by the method employed in cystoscopy. In place of the bistoury the surgeon requires a scalpel, artery clamps, grooved director, and female catheter, and the hypodermic syringe, needle, and solution.

The Operation under General Anesthesia.—The operation can readily be done in two minutes, sometimes in one. Therefore, the patient may be placed upon the table and anesthetized there by nitrous oxid and oxygen or by ethyl chlorid. Pure nitrous oxid is objectionable on account of the spasm it sometimes induces, which prevents the patient from maintaining the urethrotomy position.

The grooved staff is lubricated and introduced well into the bladder to make sure that its point has passed the membranous urethra. It is then withdrawn and held by an assistant in such a manner that its curve projects forcefully against the perineum.

The surgeon feels the staff with the forefinger of his left hand and plunges the bistoury into the skin of the perineum in the median line about 5 cm. in front of the anus and driving the point of the knife directly into the groove of the staff just where it begins to curve away from the perineum toward the bladder.

As soon as the knife is felt to strike the staff it is pushed inward along this instrument for about 2 cm. and then drawn outward and backward in such a manner as to make an incision through the urethra, the overlying tissues, and the skin, just large enough to admit the surgeon's finger. As the knife is withdrawn, the finger is introduced in its place and feels the metal staff within. This instrument is then carefully withdrawn, and as its tip passes from under the surgeon's finger, he presses this finger forward into the bulbous urethra (according to the classical description, the membranous urethra should be opened, but this is never done without very careful preliminary dissection—and incision of the bulb is entirely harmless).

The tight ring of the cut-off muscle is felt, and into this the finger is firmly but gently insinuated, thence into the prostatic urethra and into the bladder. These regions are investigated rapidly for whatever diseased condition is supposed to be present. This investigation may be assisted by counter-pressure from a finger in the rectum or from a hand

on the hypogastrium. The finger is then withdrawn and the perineal tube inserted in its place. The bladder is irrigated with one or two syringefuls of nitrate of silver solution (1:10,000), in order to clear out any clots that have been forced in, and to minimize the danger of infection.

It will be noted that the bladder is readily cleared of blood unless the internal sphincter has been torn, but that a free venous ooze drips from the perineal wound. This comes from the incised bulbous urethra, and even though this appear alarmingly severe, it does not require that the wound be packed, for the counter-pressure of the dressing upon the perineum readily stops it, while the removal of the gauze packed in the urethra is always painful and sometimes excites secondary hemorrhage that requires replacement of the tube and repacking of the urethra.

The tube may be fixed in place by sewing it to the skin. I prefer to hold it by means of two long sterilized tapes, in the center of each of which a slip knot is made, to be tied snugly around the tube. The ends of the tapes are laid X-wise along the patient's groins and lateral gluteal creases, and tied tightly either to a band about the waist or to pieces of adhesive plaster affixed to the flank.

A dressing of gauze is then placed about the tube outside of the tapes, to be held in place by a T-bandage. It is best to use the so-called "female" T-bandage with a single central piece, which piece is split up just far enough back not to interfere with the perineal tube. Its two ends are laid over the dressing on each side of the tube, crossed in front of the tube, enough extra gauze laid transversely underneath the scrotum to support this well, and the two ends of the T-bandage finally carried up and pinned to the waistband in front.

The patient's legs are then let down from the supports, and the efficiency of the perineal tube tested by injection of salt solution or boric-acid solution through its inflow. This solution should flow out rapidly through the large outflow-tube. If it does not flow out, the tube is not inside the bladder, or is plugged with clots. If it flows out in an irregular and intermittent manner, suddenly stopping off and beginning again, the tube has been inserted too far. By pushing in, pulling out, or removing the tube to examine it for clots, it is finally placed at the proper position. In order to avoid such manipulations after operation, the tube, when first placed, while the patient is still upon the operating table with his legs in the air, should be inserted just far enough to run smoothly and then pushed in about 2 cm. farther, and fixed in place by the tapes. This leaves ample leeway both for a slight tendency to working out and for the swelling about the neck of the bladder which may occur during the first twenty-four hours after operation.

Operation under Local Anesthesia.—The urethra is anesthetized by instillation of 5-per-cent alypin lubricant (p. 53), and at least fifteen

minutes permitted to elapse for this to take effect. This time is employed in the final cleaning of the operative field, getting the patient into the urethrotomy position, and beginning the infiltration anesthesia. For infiltration 0.2-per-cent cocain solution, with 1 : 10,000 adrenalin, is used.

The skin is anesthetized in the median line for a distance of 4 to 6 cm. forward from a point 3 cm. in front of the anus. The skin is immediately incised, and this incision may be carried down to the muscles surrounding the urethra without any further infiltration. These muscles are then infiltrated in the median line and laterally backward, so as to surround the bulb of the urethra with a layer of the anesthetic. Inasmuch as all the nerves run forward, the anterior portions of the deeper wound need only be anesthetized in the median line, if at all.

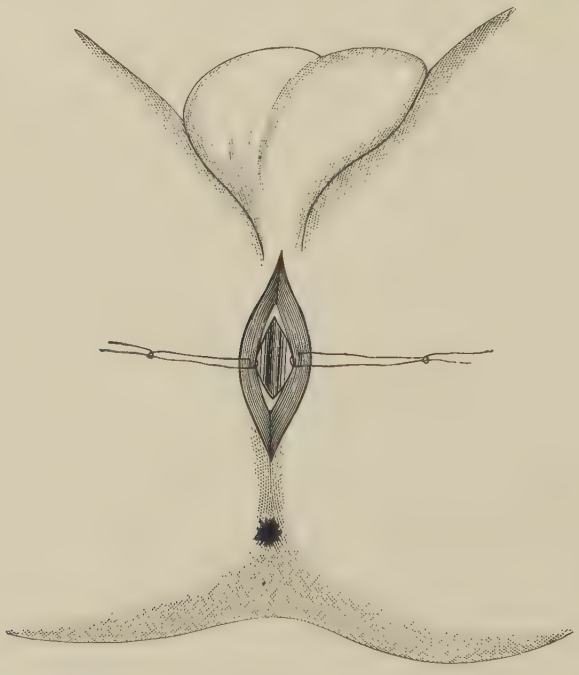

FIG. 173.—MEDIAN PERINEAL SECTION UNDER LOCAL ANESTHESIA. Grooved staff seen between separated borders of incisions (Bryant).

The grooved staff is then introduced in the manner already described and pressed forward into the perineum. The muscles overlying the urethra are divided in the median line, and after them the spongy tissue of the bulb. One or two arterial branches are cut and may be held in artery clamps, to be tied after the operation is finished. The oozing from the bulb is neglected, and as soon as the staff comes

into view this is withdrawn and the finger introduced into the urethra.[1]

Up to this point the operation should be entirely painless; but it is often difficult to force the cut-off muscle with the finger without causing the patient a great deal of pain. This may be obviated by a whiff of general anesthetic, or sometimes, but not always, by infiltration around the membranous urethra with a long hypodermic needle, guided by the finger in the bulbous urethra. But, inasmuch as the muscle may be rapidly forced, it is often wiser to tell the patient that one is about to hurt him for an instant, and then to insert the finger rapidly into the posterior urethra.

After the finger has passed the membranous urethra, the prostate and the neck of the bladder may be palpated without exciting pain so long as that part of the finger in the grip of the cut-off muscle is not moved. After the examination the finger is withdrawn, the perineal tube introduced, and the operation brought to a close in the manner described above. As the skin incision is unnecessarily long, it is my custom to shorten it by one or two sutures with chromic catgut taken through the skin, the muscles, and the incised bulbous urethra at the anterior extremity of the incision.

After-treatment.—If the patient's condition is not good, hypodermoclysis is immediately given. In any case, continuous irrigation is instituted from a tank not higher than a foot above the level of the bed, in which is kept 1-per-cent boric-acid solution at a temperature of 115° F. Unless some special thermostatic tank is used, it is better to keep not more than 1,000 c.c. of fluid in the tank, and to renew this constantly so as to keep the temperature at the proper height. On the outlet-tube to this tank a clamp is fixed to permit the fluid to flow out in rapid drops, but not in a continuous stream. This is attached to the inflow of the perineal tube, and to its outflow is attached a large rubber tube which leads over the side of the bed into a jar containing a moderate amount of carbolic acid or sublimate solution. The amount of boric-acid solution employed in the irrigation is carefully measured, and by deducting this, as well as the amount of antiseptic in the jar, the quantity of urine passed by the patient during twenty-four hours may be accurately measured. In order that the outflow-tube may not drag upon the perineal tube, it is caught by a piece of adhesive plaster wound two or three times about it, and fastened to the bed by safety pins. The tube is thus held with enough slack to permit the ordinary motions of the patient in bed, and also to permit his turning upon his side. Permission to lie either upon his back or upon the side away from that upon

[1] The inexperienced surgeon may replace the staff with a grooved director, and along this pass a female catheter from which urine issues, showing it to be in the bladder.

which the tube leads over the side of the bed is always grateful to the patient.

The treatment after the operation is conducted upon the ordinary lines of general postoperative treatment. Continuous irrigation is kept up until the fluid has flowed clear from the bladder for several hours, unless the operation has been performed for the cure of cystitis, in which case the continuous irrigation is kept up as long as the tube remains in place.

The tube is removed from the bladder, in most instances, at the end of twenty-four or forty-eight hours, unless some special indication calls for its retention. After the removal of the tube, the wound is irrigated once with peroxid.

The anterior urethra and bladder are irrigated daily, both before and after the removal of the tube, with boric-acid or permanganate-of-potash solution. As soon as the tube is removed, the patient may sit up if his condition permits. On account of the wound in his perineum he will find it uncomfortable to sit upon an ordinary seat unless he is protected by an inflated rubber ring.

After removal of the tube, if the operation has been done under general anesthesia, and unless the urethra is the seat of gonorrhea or tuberculous inflammation, the patient usually urinates only a few times through the perineal wound. Thereafter the urine begins to come by the urethra; but from time to time, for several days, the perineal wound may burst open, permitting a gush of urine to come through it, and filling the patient with despair. But he may be reassured by the statement that such an accident is to be expected. Meanwhile, he is up and about, and may leave the hospital on the third or fourth day unless some special condition requires further treatment. The urine always remains purulent for several weeks, but unless there is considerable inflammation of the bladder or retention of urine, no further instrumentation or washing of the urethra or bladder is employed. It is quite unnecessary to pass a sound after such an operation.

Complications.—Hemorrhage, spasm, and infection are the three complications to be feared.

Hemorrhage does no harm if the tube and the bladder are kept clear of clots by continuous irrigation. The bleeding is usually free for the first day, after which it decreases rapidly.

Spasm of the bladder is excited by distention of the organ with clots or by obstruction or slipping of the tube. The spasm may also be set up by the mere presence of the tube or of packing in the perineal wound. Clots may be removed by repeated gentle injections and aspirations of hot boric-acid solution, or by replacing the tube with a litholapaxy tube and aspirator. After removal of clots the bladder is irrigated with alum solution (p. 556).

If the spasm is due to the mere presence of the tube, the patient should be kept under the influence of narcotics for the first twenty-four hours, and if spasm persists at the end of that time the tube must be replaced with a smaller one or removed entirely. In the latter event the frequent use of the catheter may be required.

Infection is the great danger. It may assume any of the forms of urethral or urinary fever. Our great safeguards are water and hexamethylenamin by the mouth, nitrate of silver locally, and the perineal tube. If the integrity of the kidneys is assured no septic complications need be feared. Unfortunately, the kidneys are often congested, or even infected, and the mere cutting may suffice to excite a urethral chill, in spite of the most minute precautions; but this chill will not recur if there is efficient drainage and the patient is flooded with water by mouth or rectum.

PERINEAL SECTION FOR PROSTATIC ABSCESS

The incision is performed in the manner described above. When the finger reaches the prostatic urethra, the index finger of the left hand is inserted into the rectum and the inflamed prostatic lobes are palpated between the two. They are torn open by a gouging motion of the finger within the urethra, which thus lays open the foci of suppuration. If the prostatic lobe has not yet been broken down, but contains a great number of minute, suppurating foci, it will be felt as a spongy, friable tissue. To remove this after the manner advised by Alexander is quite unnecessary; one need only crush it into a pulp by two or three sweeps of the finger. It is unnecessary and futile to attempt either antiseptic irrigation or drainage by tube or gauze in the prostatic cavity. The perineal tube is inserted as usual and removed at the end of twenty-four hours. The perineal wound in these cases usually remains open for much longer than usual, but the patient may leave the hospital while still urinating through the perineum and wearing a gauze pad, with the assurance that the wound will heal within two or three weeks at the latest.

PERINEAL SECTION FOR DRAINAGE OF PERIURETHRAL ABSCESS OR INFILTRATION

Periurethral perineal suppuration and infiltration occur either as localized foci or as diffuse processes spreading through the perineum to the scrotum or to the adjoining subcutaneous regions. If strictly localized, the focus may be incised under a local anesthetic without opening the urethra, just as one would drain any subcutaneous focus of suppuration. This operation may cure the condition. It is more likely only

to palliate and to leave the patient in need of urethrotomy for the stricture or prostatic abscess that are commonly the causes of these conditions, or for the resulting suppurating urinary sinus.

Perineal urethrotomy under these conditions must be done with a bold hand. The urethra is opened in the median line, not with a bistoury, but with a scalpel, laying open all the tissues for several centimeters. Stricture and prostatic abscess are dealt with in the manner described elsewhere. If the foci of suppuration or urinary infiltration are widespread, each one of them is split open widely, irregular projecting masses of scar tissue are cut away; and, if this is possible without too much destruction of tissue, the whole indurated tract is excised. But every effort must be made to respect the urethral wall and to open it no farther than by the original median incision. The wound is drained by tubes or gauze, and a perineal tube inserted.

Inasmuch as the patient cannot usually be out of bed in less than ten days or two weeks, it is to his advantage to retain the perineal tube during this time, exchanging the large tube introduced at the time of operation for a soft-rubber catheter of small dimensions. The wound is dressed according to the ordinary surgical rules. Even though it takes a long time to heal, complete healing is assured so long as there is no stricture, unless the whole perineum has been cut away. In this case, a plastic operation (p. 920) upon the urethra may be ultimately necessary. I have seen perfect healing occur in a case whose fistula persisted for more than a year.

INTERNAL AND EXTERNAL URETHROTOMY WITH A GUIDE

Uncomplicated cases of urethral stricture may require internal urethrotomy, external urethrotomy, or the two together.

External Urethrotomy.—External urethrotomy for stricture is performed in precisely the same manner as external urethrotomy for drainage. A small staff may have to be employed; or, if only a filiform instrument has entered the bladder, a tunnel staff is threaded over this, the urethra opened widely, a grooved director inserted alongside of the filiform, which is then withdrawn, and the stricture at the entrance of the membranous urethra incised upon the grooved director, after which the finger is inserted into the bladder and the operation concluded as usual. In operating upon a stricture, however, it is necessary to be sure that no ridge or scar tissue is left upon the roof of the urethra, and to examine very carefully for stricture at the neck of the bladder. By turning the pulp of the index finger upward it may be swept carefully along the roof of the urethra, from the forward part of the bulb back into the prostatic portion, and if any lumps of scar tis-

sue are felt in this region they must be either divided or cut away. Stricture of the neck of the bladder is recognized as a resisting band through which the finger will not pass. If soft, and not causing any symptoms, it may be torn through and dilated with the finger. If fibrous, it must be burned through by the galvanic cautery (p. 895), since tearing it may cause excessive hemorrhage and may not cure the condition. If the bladder neck is torn, continuous irrigation may have to be kept up assiduously for forty-eight hours, to prevent the bladder filling with clots.

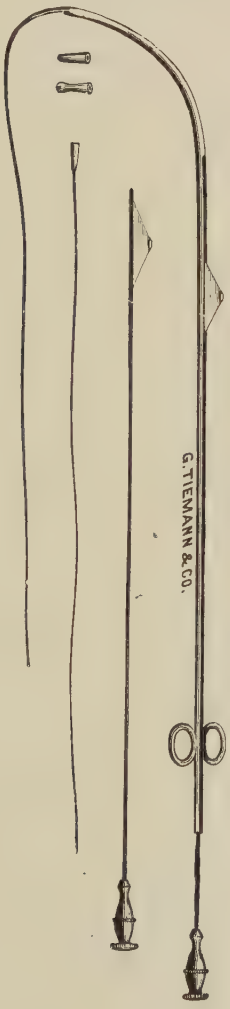

Fig. 174.—Maisonneuve Urethrotome.

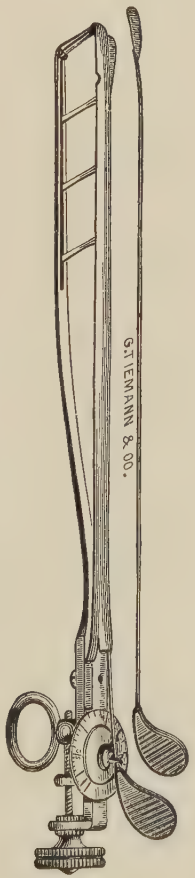

Fig. 175.—Otis Urethrotome.

Internal Urethrotomy.—If the stricture is anterior to the bulbous urethra, and impassable to any instrument except a filiform, the Maisonneuve (Fig. 174) urethrotome must be employed. This is screwed on

to the end of a filiform, pushed into the bladder, and the knife pushed home. If the stricture of the anterior urethra will admit an Otis urethrotome (Fig. 175), this is introduced (guided, if necessary, upon a filiform), screwed up to 30 or 32 French, and the knife then pulled out. It is better not to pull the knife out far enough to cut the terminal inch of the urethra, but to reinsert it into its pocket before withdrawing the instrument.

Internal urethrotomy should always be performed upon the roof of the urethra. It should not be employed for strictures in the perineal urethra, or at the bulbo-membranous junction, unless perineal section is done at the same time.

If internal urethrotomy is done without external urethrotomy (this is possible only for fairly large strictures), no instrument should be introduced into the posterior urethra at the time of the operation. If this rule is adhered to, there is no danger of urethral chill or other infectious complication after the operation.

After-treatment of Internal Urethrotomy.—If the hemorrhage is alarming and does not soon cease, it may be checked by bandaging the penis and making counter-pressure on the perineum against a medium-sized catheter introduced into the anterior urethra. If this pressure is not sufficient, it may be fortified by placing two narrow strips of basswood along the dorsal and ventral of the penis. Continental authorities employ internal urethrotomy for strictures in the perineal urethra, and therefore, in order to avoid postoperative infectious complications, always insert an indwelling catheter for several days after operation.

Internal and External Urethrotomy.—When the stricture requires both internal and external urethrotomy, two courses are open to the surgeon: He may either perform Harrison's operation—i. e., an internal urethrotomy with the Maisonneuve, followed by rapid perineal section, as for drainage, or else he may open the perineal urethra first on a small staff and cut the anterior urethra afterwards. I believe the former operation preferable in most instances.

Passage of Sounds after Urethrotomy.—The rule used to be: "Retain the perineal tube four days. Then pass a full-sized sound. If chill follows, replace the tube for four days more." Such a rule is wrong in two essential particulars: the tube should be removed on the first or second day, the first sound passed between the tenth and fourteenth.

Until the tenth day no instrument should enter the urethra. This late dilatation (for which dilators are better than sounds) is less painful and less dangerous than the early passage of instruments.

If the stricture recontracts tightly before the tenth day, this shows it should have been resected.

PERINEAL SECTION WITHOUT A GUIDE

Preliminary Sounding.—The rule that no effort should be spared in the attempt to insinuate an instrument through the stricture both before and after the anesthetic has been administered, is a good one. Yet I confess that I no longer persist in attempts at passing filiform bougies after the patient has been anesthetized, for these attempts may be carried out much more intelligently after the perineum has been opened; and if the stricture can be passed at all this is more likely to be done through the perineum than through the meatus.

The Operation.—The urethral staff is passed into the perineal urethra. If necessary, a very small staff may be used. I have never been forced to do without the staff, though by free dissection it would be possible to identify the urethra and open it even without this guide. The median perineal incision is then made a trifle farther forward than usual, opening the urethra freely in front of the stricture—i. e., between it and the meatus. The urethral walls are then pulled apart by loosely knotted sutures (Fig. 173) or by artery clamps. The urethra is thus pulled flush with the surface of the wound, its floor slit almost but not quite to the orifice of the stricture, and then, guided by touch alone, the surgeon attempts to introduce a probe through the stricture.

It is to be remembered that false passages are likely to be on the floor of the urethra, and they deviate from the median line if upon the side walls. Therefore, the point of the probe should be kept strictly in the median line, and should be guided by the roof of the urethra. Its general direction should be that of the long axis of the patient's body.

If the urethra is pulled well up toward the surface of the perineum, and the maneuver is carried out with care, it almost invariably succeeds. A perineal section without a guide is thus turned into a perineal section with a guide, as soon as the probe has passed into the stricture; but, even though it passes apparently in the right track, one should not be too sure that it is not in a false passage. The floor of the urethra is carefully divided along the probe; and, inasmuch as the tight band of the stricture is usually very narrow, a slight advance brings one to the dilated portion of the urethra behind, which is readily recognizable, after which protruding masses of scar are cut away and the operation completed as above described.

In case the probe does not pass, two courses are open to the surgeon. The quickest method is to desert the perineum, perform suprapubic section, introduce a woven catheter, or a prostatic sound or catheter with a long curve, into the bladder, and thence into the urethra down to the posterior surface of the stricture. One then returns to the perineum and opens the urethra on the point of the sound.

The second alternative is to continue in the perineum and open the

urethra by one of the various methods suggested. The so-called Unerring Thrust of Cock, which consists in plunging the knife blindly into the tissues in the general direction where the urethra ought to be, is absolutely to be condemned. Gibson's suggestion of introducing a sharp hook into the rectum, transfixing the prostate with this and making traction upon it so as to pull upon the urethra and thereby give one a suggestion as to where it lies, is but little employed. The best suggestion is that of Young. Transform the median incision into a bilateral one by diverging incisions from its posterior extremity; dissect the perineum widely, as in extra-urethral prostatectomy, and upon reaching the apex of the prostate open the urethra there.

If the median perineal section has been performed under cocain, it is sometimes possible to persuade the patient to urinate a drop or two, and close watching will show the hole from which this drop exudes.

CHAPTER LXXXV

MEDIAN PERINEAL PROSTATECTOMY AND GALVANO-CAUTERIZATION OF THE PROSTATE

MEDIAN PERINEAL PROSTATECTOMY

Position of the Patient.—The patient is put in the lithotomy position, with the hips on a sand bag. There is no advantage in any excessive elevation of the hips.

Special Instruments Required.—Grooved staff and other instruments as for perineal urethrotomy, long, narrow-bladed volsellum forceps, tonsillotomy snare, Syms's rubber-bag retractor.

Incision.—A rather long median perineal incision is made upon the urethral staff. If palpation has shown that the perineum is not very deep, I prefer to open the bulbous urethra as in external urethrotomy; but the custom of most surgeons is always to separate the bulb by section of the median perineal body and to draw it forward, bringing the anterior end of the membranous urethra into view. The urethra is then opened at this point, dividing practically the whole of the membranous urethra in the median line behind. The staff is then withdrawn and the finger introduced.

Examination of the Prostate.—The finger then enters the prostatic urethra and estimates the nature of the obstruction at the neck of the bladder. In order to do this properly, the finger must be introduced into the bladder and swept around the bladder neck on all sides—a maneuver which is very difficult if the perineum is deep, and which tears the bladder neck if this is strictured; it is made easier by counter-pressure on the hypogastrium. The finger is then withdrawn and palpation of the lateral lobes made upon a finger in the rectum. In no other way can their size and shape be correctly estimated.

Removal of the Obstruction.—If enlarged lateral lobes are felt, these are removed as follows:

A curved, sharp-pointed bistoury is introduced into the prostatic urethra on the finger until its point is opposite the most bulging portion of the lateral lobe. It is then plunged into that lobe to a depth of at least 1 cm. and drawn outward and backward, making a deep, longitudinal incision in the lateral wall of the urethra. The knife is then

withdrawn and the finger reintroduced. If the incision has been deep enough, the finger feels the lobulated tissue of the hypertrophied gland and proceeds to remove this in the following manner:

The finger is first worked outward between the hypertrophied tissue and the so-called capsule, its movement being directed by the sensation of lobulated tissue on one side and smooth capsule on the other. The lobe usually separates very readily on the outer side and the finger is rapidly swept up and down until the lobe is quite free on its outer aspect. The long, thin volsella are then inserted, and with these the lobe is grasped and pulled down gently (too great traction only tears the tissue), while the finger reaches farther and farther upward, dissecting around the upper end of the lobe. Finally, the whole lobe is freed except that part of it adherent to the mucous membrane. This is freed as much as possible, but pieces of the mucous membrane usually adhere to the lobe when it is finally removed by the forceps.

The same maneuver is then performed, if necessary, on the opposite side.

If there is general enlargement of the gland, the dissection of the outer aspect of one lobe naturally carries the finger underneath the median bar and over to the other side of the urethra. There is no objection in these cases to removing the whole prostate *en masse,* including the prostatic urethra, except that this may make an excessively large mass to deliver through the perineal incision. It is better to avoid this difficulty by tearing the mass out in several pieces, since overstretching of the membranous urethra is carefully to be avoided. If there are pediculated median lobes, these may be caught in the volsella and removed by snipping the mucous membrane at their base with long scissors; but it is productive of far less hemorrhage to employ a tonsillotomy snare, slipping this over the forceps and growth, and snaring off the pedicle.

The operation is closed by the introduction of a double-current drainage-tube.

Difficulties in the Operation.—Two contingencies may be encountered in this operation which render it impracticable: The hypertrophied lobes may be so fibrous as to be irremovable by enucleation, or the obstruction may be due to a small median bar without any marked hypertrophy.

In either case, it is far preferable to give up the perineal prostatectomy and either to perform Chetwood's operation or suprapubic prostatectomy.

Difficulties in enucleation of the hypertrophied tissue may usually be overcome by firmly grasping the lobes in the volsellum. In some cases deep hypogastric pressure is of great assistance, or a finger in the rectum may help; but if the perineum is very deep and the projection

of the prostate largely intravesical, the Syms bag is a great help in drawing down the gland. This bag should be filled with water, not with air. Its tube is then clamped and drawn upon firmly during the operation as a retractor.

If the lobes under process of enucleation are not tightly grasped by the volsellum, they may slip into the bladder unless the Syms bag is used; and, once in the bladder, they are often very difficult to recover. They are best removed by a lithotomy forceps.

Careful operation will always avoid the one grave difficulty of the procedure, viz., tearing into or through the capsule of the hypertrophied lobe. If this accident should occur, it is recognized by the fact that the finger passes into a space on all sides of which the tissues are smooth, and in which none of the lobulated, hypertrophied gland can be felt. Such a tear should be closely packed with gauze, in order to avert hemorrhage; otherwise, no gauze packing is required. Tearing of the bladder neck should be avoided as far as possible, though some tearing of this part of the urethra is usually unavoidable.

Postoperative Care.—Continuous irrigation must be begun immediately—before the patient leaves the operating table; otherwise clots may accumulate before the patient gets into his bed, which cannot be removed without great difficulty, and may require suprapubic section. If the intravesical bleeding is severe, it may be temporarily checked by copious irrigation with a mixture of a heaping teaspoonful of Squibb's compound surgical powder to the pint of hot water; but the immediate use of liberal, constant irrigation is the secret of success as far as hemorrhage is concerned. Irrigation is kept up until the fluid no longer returns bloody, and for at least six hours after operation.

It is usually better to remove the perineal tube within two days after operation, though if there is very marked cystitis and the patient's condition is good, the tube may be kept in a longer time; but it is of the greatest importance to get these patients out of bed as soon as possible, even though their condition is apparently fairly good. The patient who is got out of bed within three days after operation recovers much more quickly than he who is kept on his back for a longer time.

It is well to pass a single, full-sized sound into the urethra at the end of the first or second week after operation, to be sure that no tendency to stricture formation is occurring during the healing, although stricture is a very unusual complication of the convalescence. Watson states that he knows of only 6 cases of stricture of the prostatic urethra following this method of perineal prostatectomy. If such stricture occurs, it requires Chetwood's operation or suprapubic section.

Postoperative Complications.—The immediate postoperative complications of hemorrhage, sepsis, and uremia should be dealt with according to the rules laid down above and in Chapter XXXV.

The complications especially to be feared after this operation are epididymitis, sexual impotence, incontinence of urine, and persistence of retention.

Epididymitis.—Infection of the epididymis may complicate prostatic hypertrophy itself or may result from any of the operations undertaken for its relief. It is most common, however, after intra-urethral prostatectomy (and after extra-urethral prostatectomy by the method of Proust). The inflamed epididymis should be immediately incised if it assumes any importance.

Impotence.—Most patients whose prostates have been operated upon note some diminution in the amount of semen ejaculated, but our experience with prostatic abscess proves that the lateral lobes of the prostate may be entirely destroyed without in the least affecting the patient's potency.[1] Yet anywhere from 25 per cent to 75 per cent of patients whose prostates are removed for hypertrophy are completely impotent thereafter.

Various explanations for this fact have been offered. Young alleges the impotence to be due to destruction of the vasa deferentia and entitles his operation "conservative" prostatectomy because it spares these structures. But intra-urethral perineal prostatectomy, if properly performed, respects the vasa deferentia quite as adequately as Young's operation does; moreover, division of the vasa does not necessarily entail impotence (though it renders the patient sterile).

It is probable that postprostatectomy impotence is due rather to destruction of the prostatic urethra and to operative shock. To avoid it we should spare the floor of the prostatic urethra in removing the lateral lobes, and operate as rapidly as possible. But on account of the age of our patients postprostatectomy impotence will always figure large in statistics.

Urinary Incontinence.—A minor degree of incontinence of urine—i. e., a lack of tightness in urination, whereby the patient may lose from a few drops to a teaspoonful every day or so—is a complication of moderate frequency after this form of prostatectomy. It is due to the cutting and stretching of the membranous urethra, and in order to avoid it, I prefer to open the bulbous urethra rather than the membranous portion of the canal, and never to attempt the removal of unwieldy masses of prostatic tissue through the incision. It is better to tear them up in small pieces before they are removed.

Grave incontinence sometimes ensues for no obvious reason; but it is extremely rare, unless the internal sphincter has been badly torn.

Retention of Urine.—Failure to relieve the prostatic obstacle is usu-

[1] I have operated upon 10 cases, not one of whom has shown diminution of sexual vigor. Two of them begat children within two years of the operation.

ally due to faulty technic or to neglect of the important bar at the neck of the bladder, and this is primarily due, as has been stated elsewhere, to the surgeon's ambition to remove the prostatic hypertrophy rather than to reduce the obstruction to urination.

Stricture of the prostatic urethra [1] may, however, be the cause of the retention.

GALVANO-CAUTERIZATION OF THE PROSTATE

The advantage of burning through an obstruction at the neck of the bladder is twofold. In the first place, it obviates the necessity of a prostatectomy which may be next to impossible, and, in the second place, it leaves an incision in the neck of the bladder which has the double advantage of not bleeding and filling the bladder with clots and of healing so slowly that the burned groove practically leaves precisely the same opening in the bladder neck as is felt at the time of operation. The neck of the bladder should be cauterized after perineal incision and palpation of the obstruction according to Chetwood's technic. The blind Bottini operation should never be performed. The Chetwood operation may sometimes be advantageously combined with prostatectomy.

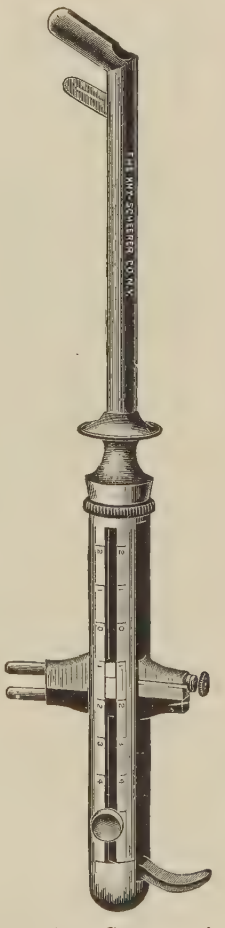

Fig. 176.—Chetwood's Prostatic Incisor.

Technic.—The urèthra is opened and the prostate explored in the manner already described. The shape of the obstacle determines the method of attack. Bar or stricture is divided by a single cauterization. A median lobe may be excised by two cauterizations in V-shape. Lateral lobes, if enlarged, are removed by the intra-urethral method.

Technic of the Galvano Incision.—The accompanying figure shows the instrument employed (Fig. 176). It resembles a short, stout Bottini incisor, the knife of which is drawn out by the surgeon's direct pull instead of by a ratchet wheel. The length of the incision is regulated by a small stop-pin, which may be set at any desired point. The battery is the same that is required for the Bottini operation,[2] and it is customary to allow a stream of cold water to course from the meatus through the urethra and out of the perineal wound

[1] Cf. *Trans. Am. Ass'n Gen.-Urin. Surg.*, 1909, vol. iv.

[2] It should give a constant current of 4 volts, 50 ampères.

while the burning is being done. The instrument must be tested before using in order that the amount of electricity required to heat the knife to a white heat may be justly appreciated.

The surgeon introduces the instrument into the perineal wound, and turns it to hook over the prostate in the required direction. He then inserts the index finger of his left hand (protected by a rubber stall) into the rectum, and bears down on the point of the instrument until it can be distinctly felt on the front wall of the rectum above the prostate.

The cooling apparatus having then been adjusted and only a very small stream of water being allowed to flow, all is ready to begin. From

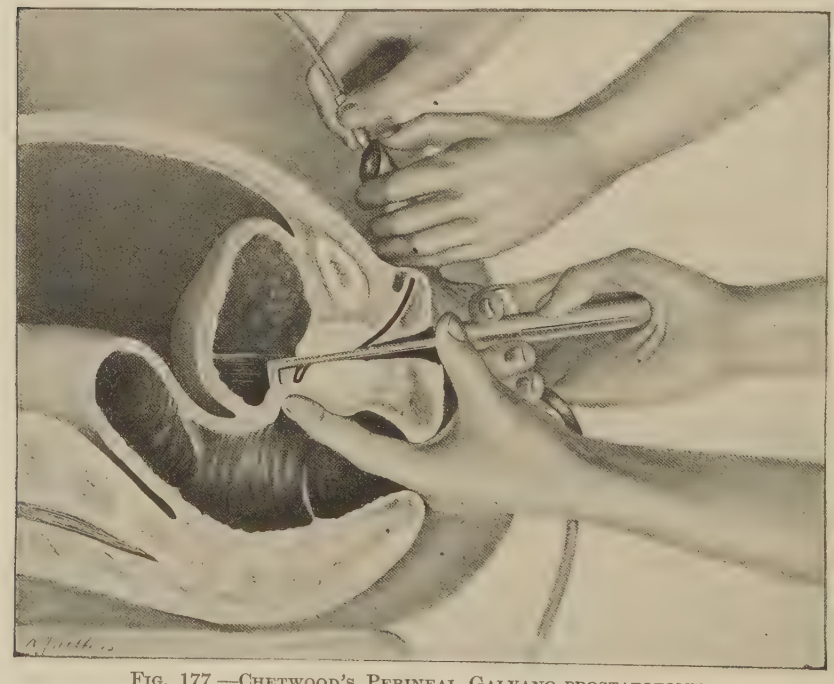

Fig. 177.—Chetwood's Perineal Galvano-prostatotomy.

this point it is best to proceed by the watch. The electricity is turned on, and five seconds are allowed for the knife to become heated. It is then very slowly withdrawn [1] (Fig. 177), from sixty to ninety seconds being employed in drawing it out, and fifteen seconds for its return. The instrument is then extracted, the cold-water nozzle inserted into the perineum, so as rapidly to cool the incised tissues, and then a finger is introduced into the wound and the groove carefully palpated. It should

[1] The length of the incision varies from 0.5 to 3 cm. If in doubt, the surgeon may better make a short incision first and lengthen it later.

extend on an even plane from the trigone to the urethral floor, completely dividing the bar.

Frequently, all the tissues will be found divided with the exception of the urethral mucous membrane, which is readily torn by the finger. But if a dense bar remains this should be divided by a second cauterization.

A double-current perineal tube is inserted and *after-treatment* conducted as for perineal prostatectomy.

Complications.—There are no operative complications peculiar to this procedure. The postoperative complications are similar to those of perineal prostatectomy. Some surgeons find the operation peculiarly productive of incontinence of urine. I have employed it 25 times, with but 1 death, 1 grave incontinence, and 1 or 2 of minimal incontinence (none of these has to wear a cloth to catch the drip). Dr. Chetwood's series shows about the same results.

CHAPTER LXXXVI

BILATERAL PERINEAL SECTION

In the preceding chapter the various operations upon the urethra and prostate that are performed through a median perineal incision have been described. The bilateral, or transverse, incision is employed for operations that require a wide opening of the perineum and a good view of its deeper recesses. The operation is much more difficult than the median operation, but for certain conditions it is the procedure of choice. It is employed chiefly for operations upon the prostate and the seminal vesicles. Prostatectomy through this incision was first suggested by Dittel, who laid the perineum open and removed V-shaped sections of the lateral lobes of the prostate without opening the urethra. Such an operation fails to take into account the precise nature of the urethral obstruction, and is, therefore, to be condemned. Any prostatectomy, to be successful, implies palpation of the prostatic urethra from within, and of the neck of the bladder, in order to discover the nature of the prostatic obstruction and to prove that it has been removed.

EXTRA-URETHRAL PERINEAL PROSTATECTOMY

The modern operation of extra-urethral perineal prostatectomy was devised by Proust. The technic of Young is preferable to that of Proust, inasmuch as Young attacks the prostate through two incisions —one for each lateral lobe—whereas Proust splits the prostate in the median line, thereby destroying the vasa deferentia and getting at the lateral lobes only indirectly.

Some of Albarran's suggestions are useful, and we shall, accordingly, describe the operation as performed by Young, noting some of Albarran's modifications.

Although Young uses this operation upon all cases, it is certainly not the operation of choice excepting when the patient's condition is such as to withstand an operation of at least twenty minutes' duration, and unless the obstruction is chiefly due to enlargement of the lateral lobes or to sessile median growths. Pedunculated growths are much more readily removed from within the urethra, prostatic bars and stric-

tures are more readily burned through by the galvano-cautery, while any of these obstructions may be handled by the suprapubic route.

Position of the Patient.—Inasmuch as the operation is done in full view, and by the sense of touch aided by the eye, it is important that the patient's perineum should be elevated to a considerable height. A small sand bag does not suffice. The patient's position should be such that the perineum is almost horizontal, the buttocks very highly elevated, the knees and thighs very strongly flexed.

Special Instruments Required.—The special instruments required for Young's operation are his four retractors, forceps for clamping the prostatic lobes, enucleator, and vesical tractor, also a sound, a staff, and a sharp-pointed bistoury.

The prostate can usually be depressed sufficiently without the use of the tractor, and Albarran's technic of using the finger in the urethra to depress the prostate is, I believe, generally preferable.

Sound.—A full-sized sound is introduced into the urethra as a guide.

Incision.—The operation may be performed through a curved, prerectal section running from one ischial tuberosity to the other, and passing about 3 cm. in front of the anus (Proust); or one may make two lateral converging incisions and connect them in front by a snip of the scissors (Young).

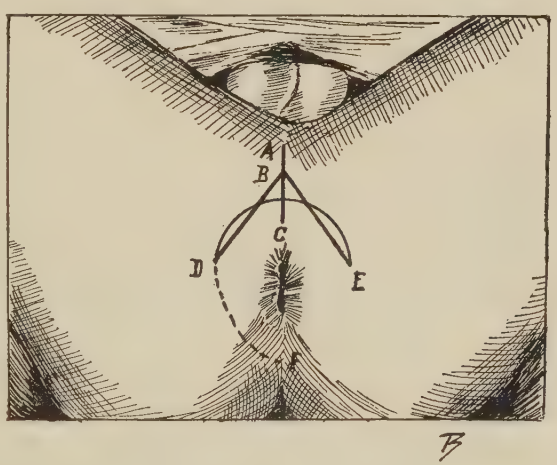

FIG. 178.—PERINEAL INCISIONS. A C, median incision; D B E, Young's incision; D E (curve), Proust's incision; F D E, incision for vesiculotomy.

After incision of the skin, the lower flap is drawn back and the fingers pushed into the loose cellular tissue on either side of the perineal body. The bulb of the urethra, surrounded by its muscles, is fully exposed and the perineal body divided with scissors immediately behind it. Young's bifid retractor is then introduced posteriorly and strong traction made while the bulb of the urethra is held up and carefully dissected free.

It is most important in this, and the succeeding steps of the operation, to stick close to the urethra, feeling one's way on the sound in that canal. As soon as the bulb has been freed and drawn well forward, exposing the beginning of the membranous urethra, blunt dissection is made on either side to free the cellular tissue and the loose muscular bag

of rectum is felt adherent to the membranous urethra. A small band of muscle fibers runs from the rectum to the membranous urethra, and this muscular band, the recto-urethralis muscle, is divided *with great care very close to the membranous urethra.*

If the surgeon is in doubt as to his bearings at this point of the operation, he should insert a finger into the rectum in order to feel his way most carefully, for the bowel lies right against the urethra and may easily be opened. As soon as the recto-urethralis is cut, the finger may be swept across the front of the rectum, and this pushed back safely out of the way.

The space thus reached is called by Proust *l'espace décollable rétro-prostatique.* Blunt dissection discloses the prostate. The bifid retractor is now exchanged for the broad posterior retractor, and two lateral, narrow retractors are inserted. Then the blunt dissection is carried upward along the posterior surface of the prostate, carefully following the lines of this organ and pushing back the rectum until the whole of the posterior surface of the prostate has been freed from adhesions and stands out plainly in the wound. It will then be seen that there is a space about 1 cm. in length lying between the compressor urethræ muscle in front and the apex of the prostate behind. The membranous urethra is opened at this point.

In opening the urethra by a stroke of the knife, the unfamiliar surgeon may find it difficult to cut through the mucous membrane. He may be lost in the tissues of the canal, and had, therefore, before performing this step, better remove the sound and replace it by a grooved staff, upon which incision is more readily made. The finger is then introduced into the membranous urethra and thence into the prostatic urethra, and the urethral surface of the gland and the bladder neck carefully palpated as in intra-urethral prostatectomy.

According to Young's technic, the vesical tractor is now introduced, opened, and drawn upward and forward so as to make strong traction upon the lateral lobes of the gland.

According to Albarran's technic, the finger is introduced and traction made with this.

The surgeon now takes a long, sharp-pointed bistoury and plunges this about 2 cm. deep into one lateral lobe near its apex and about 1 cm. from the median line. The knife-blade should penetrate the prostatic tissue close to the urethra, separating the lobe partly from that canal. The knife is then withdrawn with a sweep, dividing the capsule of the gland longitudinally for about 2 cm. The finger is then introduced into this incision and the hypertrophied lobe freed as in the case of intra-urethral prostatectomy.

The outer capsule of the lobe, consisting as it does of a mass of compressed normal gland tissue, besides the principal capsule of the gland,

is much thicker than the capsule encountered in intra-urethral prostatectomy; but the test for the right plane to work in is the same—the feeling of lobulated prostatic tissue on one side and of smooth capsule on the other. The outer surface of the lobe is freed either by the enucleator of Young or (as I believe to be preferable) by the finger; and this enucleation is carefully carried well up under the bladder neck in order to enucleate a part, at least, of the median bar or lobe, if this exists. The loosened gland tissue is then seized with the specially devised forceps and drawn downward, while its outer surface is fully freed. The inner surface of the hypertrophied lobe adheres strongly to the posterior urethra.

If the original incision with the knife has been deep enough, and has reached close beneath the urethral capsule of the gland, these adhesions have been in large measure freed by this incision; but a certain amount of freeing still remains to be done, and this, if done carelessly, usually results in rupture of the mucous membrane of the prostatic urethra.

It is here that Albarran's technic is especially advantageous. Keeping a finger within the posterior urethra, and pulling the separated lobe strongly upward, he gets it free from the urethra by snips with the scissors, judging the manner of his snipping by the sensation imparted to the finger in the urethra. In this way the urethral mucous membrane may almost always be spared.

Having removed a single lateral lobe in this way, its fellow is removed through a similar incision in the opposite side.

After the lateral lobes have been removed, the finger is introduced into the urethra and through the bladder neck, which is forcibly drawn downward. A finger is then introduced into one of the prostatic incisions, and the region of the bladder neck carefully palpated for further masses of hypertrophied gland tissue. These, if found, are carefully removed.

Young removes middle lobes through one of the lateral incisions by turning his tractor downward and pressing upon them; but the accuracy of this procedure is not to be compared with that of employing the finger as a tractor. Pedunculated lobes should be snared off.

At the end of the operation an irrigation tube is placed in the bladder through the wound in the membranous urethra, which may be closely sutured around it, if it has been unduly enlarged. Careful gauze packing is made in the incisions of the prostate, in order to prevent bleeding; but no extraprostatic packing is required.

In order to prevent subsequent sloughing of the rectum, Young advises that the edges of the levator ani muscle, which are now plainly visible in the wound, be caught together by a strong catgut suture. This procedure is not difficult, and certainly throws the rectum well back

out of the wound. The lateral parts of the external incision are then closed up to the central point, whence the perineal tube and gauze issue.

Difficulties of the Operation.—The difficulties of the operation are similar to those met with in intra-urethral prostatectomy. A fibrous lobe is very difficult to remove without tearing the prostate all to pieces, and an obstruction due to median bar should certainly not be attacked by this method. Pedunculated median lobes cannot be conveniently gotten out through this incision, and are best removed with the snare through the urethra, as described in intra-urethral prostatectomy.

After-treatment.—A few hours of continuous irrigation usually suffices; the gauze drains are removed at the end of eighteen hours; the perineal tube at the end of twenty-four or forty-eight hours; and the patient is then promptly gotten out of bed if that is possible.

Postoperative Complications.—The only special postoperative complications are hemorrhage and injury to the rectum.

Intravesical hemorrhage does not occur if the operation has been properly performed, but several deaths have occurred from hemorrhage into the wound. This is likely to occur only in old, septic individuals, for whom extra-urethral prostatectomy is not peculiarly suited, except at the hands of an expert. Young seems to have lost no cases by this accident.

Injury to the rectum may occur at the time of the operation. I tore the rectum in the first three cases in which I operated by this method. The wound should be promptly sutured, and special care should be taken to bring together the levator ani muscles in front of the bowel. In my three cases the wound in the bowel healed kindly, but others have not been so fortunate.

It is stated that the bowel may slough after operation, or that the rectal tube may be forced through it. I question the probability of either of these accidents, unless the bowel was greatly injured at the time of operation.

Incontinence of urine is less likely to occur after this form of perineal prostatectomy than after the intra-urethral operation, since the external sphincter is not interfered with. The danger of incomplete removal of the prostatic obstruction is equally great in all forms of perineal prostatectomy.

PROSTATECTOMY FOR NEOPLASM

Although unsuspected macroscopic prostatic neoplasms may sometimes be successfully removed by any type of prostatectomy, a neoplasm of sufficient importance to be diagnosed before the operation can only

be successfully extracted by removing the whole prostate together with its capsule. This operation was first performed by Leisrink in 1882, a similar operation was performed by Fuller in 1898, and the technic has been finally perfected by Young (1904).

Instruments Required.—The instruments required are practically the same as those used in extra-urethral prostatectomy.

The Operation.—The position of the patient is the extreme lithotomy position, and the preliminary work of exposing the prostate is carried on in the same manner as for extra-urethral prostatectomy. But the dissection of the tissues from the prostate should be carried not only up to the upper end of that gland, but also over the seminal vesicles as well. After these structures have been thoroughly freed, the incision is made in the membranous urethra and Young's tractor introduced into the bladder and opened. The handle of the tractor is then depressed and the membranous urethra divided transversely close to the apex of the prostate.

By further depressing the handle of the tractor, the pubo-prostatic ligament is exposed and easily divided by scissors, thus completely separating the prostate from all important attachments (except posteriorly). The lateral attachments, which are slight, are easily separated by the finger. The posterior surface of the seminal vesicles is then freed by blunt dissection, the now mobile prostate being drawn well out of the wound. (Young.)

The fascia behind the vesicles is carefully preserved by blunt dissection close to those organs. The mass is then drawn strongly downward so as to bring the neck of the bladder close to the skin wound, and this is incised in the middle line in front, and about 1 cm. above the neck of the bladder. The incision in the bladder wall is continued down on each side of the neck of the bladder until the trigone is exposed. The ureters are searched for and the line of incision carried across the trigone so as to pass 1 cm. in front of the ureter orifices. By blunt dissection the base of the bladder is then pushed upward from the anterior surface of the seminal vesicles and vasa deferentia. These are then freed from the bladder, leaving as much of the fat and areolar tissue attached to the vesicles as is possible. The vasa deferentia are drawn down by a blunt hook and divided as high up as possible, care being taken not to damage the ureters. The seminal vesicles then come down more easily. Their upper ends are carefully freed and the whole mass removed.

Reconstruction of the vesico-urethral gap is now necessary. The stump of the membranous urethra is identified by means of the passage of a catheter from the meatus if necessary. The bladder, which has

retracted far up into the pelvis, is caught with forceps and drawn down again.

The first suture is placed by inserting the needle through the triangular ligament above the urethra, and then out through the anterior wall of the membranous urethra, then through the anterior wall of the bladder in the median line from within out, care being taken to include only the submucosa and the muscle. This leaves the knot outside the junction of the two approximated edges. The thread is left long. Lateral sutures, including the periurethral muscular structures below, and two posterior sutures, complete the anastomosis of the membranous urethra with a small ring into which the anterior portion of the margin of the vesical wound has been fashioned by tying the sutures. The remainder of the vesical wound is now closed with sutures. (Young.)

The wound is freely drained with gauze, its lateral branches being closed.

OPERATIONS UPON THE SEMINAL VESICLES

The same incision as that used by Young for prostatectomy is admirably adapted to operations upon the seminal vesicles. The operation is begun in the manner described above. The rectum should be separated from the urethra not only as far as the prostate, but also beyond it, to reach the seminal vesicle. The section should hug the prostate and vesicle, keeping as far away from the rectal wall as possible. When the vesicle is reached it may be incised (vesiculotomy) or excised (vesiculectomy). If the wound is very deep the tissues to be operated upon may be brought more fully into view by hooking a volsellum into the prostate and making traction upon this.

Vesiculotomy.—When the vesicle has been thoroughly exposed, it is split from end to end and its interior thoroughly curetted. A cigarette drain is then packed into this cavity and led out through the perineal wound, which is closed in the usual manner. This drain is withdrawn after forty-eight hours and replaced by a small tube, which is kept in as long as seems necessary.

Vesiculectomy.—The sheath of the vesicle is split and an effort made to free the organ by blunt dissection with the finger or the handle of a scalpel. If the fundus of the vesicle is not adherent, the organ comes away very readily. It is divided at its entrance into the prostate and extracted. The vas may be divided and extracted with it; and, if preliminary castration has been done, the whole of the vas may be pulled out through the urethral wound. If the fundus of the vesicle is adherent, its enucleation may be simplified by dividing it as it enters

the prostate and endeavoring to shell it out from below upward; but this maneuver may be extremely difficult, and, inasmuch as the vesicle lies immediately below the peritoneum and is probably adherent to this, rather than risk opening the peritoneal cavity, it may seem wiser to amputate only as much of the vesicle as can readily be freed, and to be satisfied with curetting or cauterizing its remains. The operation is closed in the same manner as that employed for vesiculotomy.

CHAPTER LXXXVII

INTRAVESICAL OPERATIONS

LITHOLAPAXY

Preparation of Patient.—If when first seen the patient is suffering from an acute cystitis, he should be put to bed and kept there until the attack subsides under treatment. If unaffected by treatment, litholapaxy may still be performed, though I confess a preference for suprapubic section.

If the cystitis is not extremely acute, preparation for litholapaxy need occupy but forty-eight hours, while the patient is freely flushed with water and hexamethylenamin. It is well to irrigate the bladder twice a day with boric-acid or silver solution in order to reduce infection as far as possible, and to estimate the caliber of the urethra by the introduction of a blunt sound or a bulbous bougie. Shaving the pubes is proper, and antiseptic preparation should be made as for suprapubic section, since this may be required if the litholapaxy fails.

The only actual antiseptic preparation necessary for the litholapaxy, however, is a thorough disinfection of the penis and preputial cavity by green soap and bichlorid and a prolonged irrigation of the anterior urethra immediately before beginning the operation.

Anesthesia.—Small stones may be crushed under local anesthesia, such as is employed for cystoscopy. The operation is then best performed with the Chismore combined lithotrite and pump.

For multiple stones, stones more than an inch in diameter, or complicated cases, general anesthesia is preferable.

Instruments Required.—Besides the usual tables, rubber cloths, basins, towels, etc., I carry the following outfit to all litholapaxies:

One searcher.

Three lithotrites, at least.

Two aspirators, and at least three tubes.

One sound—full size for the individual.

One woven elbowed catheter.

One large piston syringe (150 c.c.).

The apparatus for making solutions of 2-per-cent boric acid, 1 : 5,000 nitrate of silver, and alum suspension.

Nearly every operator of prominence has his own lithotrite, and many have devised washing-bottles and special tubes. With any form of apparatus the operation may be done, and with more or less rapidity and success, according to the deftness of the surgeon. On these different questions it is impossible to enter freely here, as it is impracticable to describe all the instruments employed at various hands. I shall only describe the instruments which I employ, and touch briefly upon the more notable points of those commonly used by other operators.

Fig. 179.—Bigelow Lithotrite.

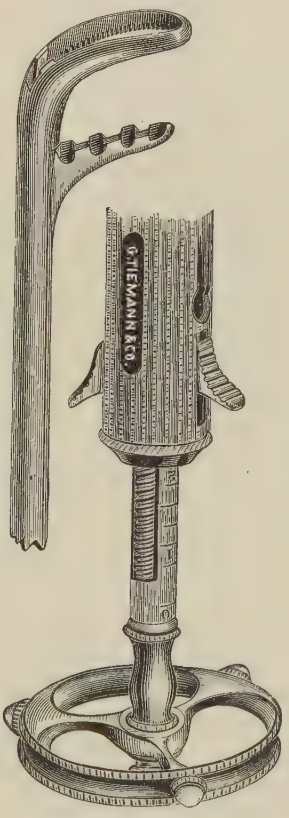

Fig. 180.—Keyes Lithotrite.

Lithotrites.—The lithotrite (Fig. 179) may be called upon in any operation to perform two very different functions—viz., to crush a stone of some size and perhaps of great hardness, and to catch and crush small crumbling fragments that are only just too large for aspiration. For the former purpose a heavy, powerful lithotrite with a fenestrated fe-

male blade (Fig. 180) is required, while for the latter I prefer a lighter instrument with a solid female blade of a broad duck-bill shape. A complete outfit should include these and several intermediate varieties of lithotrites, as the surgeon's judgment dictates. Small lithotrites are made for children.

The powerful lithotrite should possess several characteristics: (1) The male blade when screwed home should pass quite through the female blade: an instrument thus constructed cannot become clogged; (2) the wheel (Fig. 180) or globe (Fig. 179) handle of the instrument must be large enough to afford firm

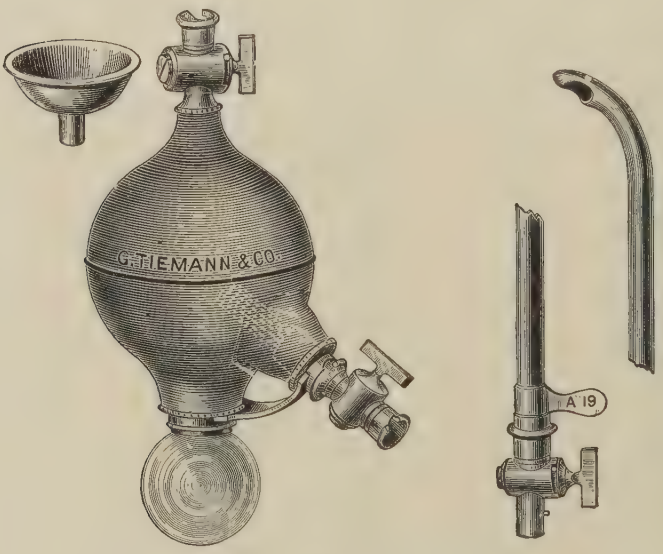

Fig. 181.—Bigelow Aspirator and Washing-tube.

purchase for the surgeon's hand (instrument makers have a tendency to neglect this point upon which the utility of the instrument largely depends); (3) the catch for adjusting the screw action should be sufficiently prominent to be worked without the least difficulty. In my father's instrument (a modification of Réliquet's) the catch is saddle-shaped (Fig. 180). Chismore had added to his lithotrite an automatic hammer such as dentists use, and with it claims to crush the hardest and largest stones with scarcely any effort.

Fig. 182.—Keyes Washing-tube.

For small, *soft* fragments a flat-bladed, duck-bill instrument is useful. This instrument should only be employed toward the end of the operation. The nonfenestrated blade has a tendency to clog, but this

instrument will, in my hand, pick up fragments that no other lithotrite will catch. For small, *hard* fragments I employ a light, small-bladed fenestrated instrument.

The Aspirator.—The aspirator or washing-bottle of Bigelow (Fig. 181), as now perfected, I prefer to any other. The aspirating lithotrite of Chismore is useful for office operations upon small stones.

Washing-tubes.—The major part of the washing I do with Guyon's tube, though my father prefers the Bigelow (Fig. 181). To catch the last fragment the Keyes tube (Fig. 182) is useful. I employ it with the beak turned downward. Its tip then depresses the floor of the bladder into a dependent pouch whose contents are readily aspirated into the eye which overhangs it.

The Operation.—This is litholapaxy: To catch the stone with an instrument passed through the urethra, to fragment it sufficiently for the

FIG. 183.—SHOWING THE MANNER OF HOLDING THE LITHOTRITE WHEN OPENING AND SHUTTING IN THE SEARCH FOR FRAGMENTS. (MORROW.)

detritus to pass out through a tube, and to suck this out by some suitable apparatus.

The patient is placed upon the operating table on his back, with his feet widely separated and a sand bag beneath his hips. He is then cathe-

terized and 100 to 150 c.c. of warm boric-acid solution injected into the bladder. A lithotrite, selected in accordance with the size of the stone, is then introduced (Fig. 183). It may have to be assisted over the prostate by pressure on the perineum. Once in the bladder, the instrument is passed gently onward until its jaws touch the back wall. Then, gentle tappings along the side wall quickly indicate the position of the stone. When this is found, the jaws of the lithotrite are turned away from it, opened, returned while open over the spot where the stone was

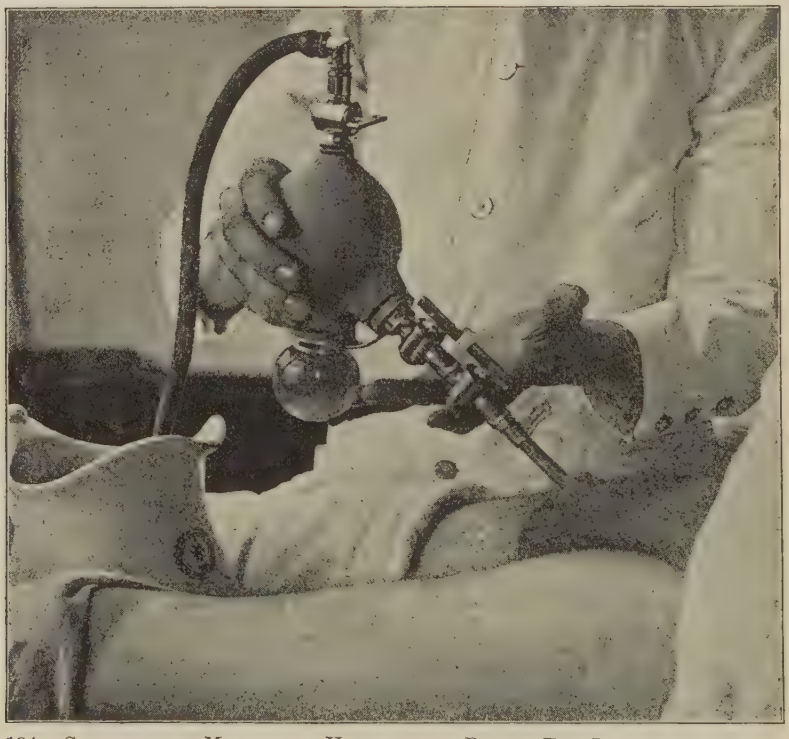

FIG. 184.—SHOWING THE MANNER OF HOLDING THE BULB. THE LEFT HAND HOLDS THE WEIGHT WHILE THE RIGHT MANIPULATES IT. (Morrow.)

found, and, being gently closed, the stone will be grasped. The screw power is now thrown on and a half turn given to the screw. This fixes the stone. As the half turn is being given, the jaws of the lithotrite are to be gently moved away from the bladder wall toward the center of the bladder. If a portion of mucous membrane has been entrapped with the stone, the operator instantly appreciates it as an obstacle to the easy rotation of the shaft of the instrument. In such case the jaws are unlocked, the stone allowed to drop out, and another effort made to catch it more cleanly. If the instrument rotates freely to the center of the bladder, the screw power is firmly applied and the stone fragmented. The

fragments fall on either side, and are picked up and again and again fragmented.

Inasmuch as the fragments have a tendency to gravitate back to the spot where the stone originally lay, this must be remembered.

With a fenestrated instrument there is no occasion to stop to clear the jaws or to test them for clogging. The work goes evenly on until the operator infers that he has manufactured enough *débris* to make a creditable wash, and then a tube, as large as the urethra will admit, is introduced, the washing-bottle coupled, the stopcock turned, and by alternate compressions and relaxations of the bulb the fragments are sucked up into the bottle and fall into the receiver beneath (Fig. 184). Care must be taken to allow no air to enter the bladder. In the case of small tubes this is best averted by pausing in the introduction, when the eye is yet within the prostatic sinus, and filling the tube from a piston syringe. If the tube is large the bottle is simply coupled before the eye reaches the bladder; then, having turned on the stopcock, the operator waits a moment until he hears the air which was contained in the tube bubble up within the bottle. Now the bulb is compressed, the prostatic sinus is flooded, and the end of the tube, as it were, floated in through the open gate at the bladder's mouth.

If the tube becomes clogged by a fragment (which the competent operator at once recognizes by the increased resistance to his pressure upon the bulb), a forcible compression of the latter will often dislodge the impacted body. Should this maneuver fail, the bottle must be uncoupled and a probe run down the tube to drive out the impacted piece. Under no circumstances should a tube be withdrawn with a sharp fragment impacted in its eye, for the fragment will tear the deep urethra and may cause prostatic abscess.

The lithotrite is again introduced, some more *débris* made and removed, and so on until no further click of fragments can be heard as the water swashes in and out of the bladder either by the operator or by an assistant's ear placed against the hypogastrium. For this final search I use the Keyes tube, sometimes supplementing it with Guyon's tube.

When listening for the click of stone the unaccustomed ear may be misled by the click produced when the bladder wall catches in the eye of the instrument. This is a muffled, double click, quite distinct from the single sharp click of a fragment of stone. If in doubt the tube may be pushed well in or over to one side and the bladder click thus elicited.

After the surgeon has thus satisfied himself that no fragment remains in the bladder, a catheter is again introduced and the boric-acid solution drained away. A few rapid washes usually suffice to clear the bladder of blood. If not, this is accomplished by alum injections. To close the operation nitrate-of-silver solution (1: 4,000) is injected. As

the last of this is entering the catheter, the instrument is slowly withdrawn, so that the solution bathes the posterior and the anterior urethra. As soon as a few drops trickle from the meatus the catheter is reintroduced and the bladder emptied. The patient is then returned to his bed.

I know no operation of which the success depends so entirely upon the surgeon's skill and technic. What is most difficult to the novice is to crush the stone methodically and deliberately. The first catch and crush is usually easy, and perhaps in a given case it would be possible for an unskilled operator to make quick work of the larger fragments without any particular method; but long before the last fragment has been crushed such an operator will find himself pottering about in the bladder, never finding any considerable fragment, although the clicks upon the tube assure him that there is plenty of work left to do. This deadlock may continue quite indefinitely, and the only way to avoid it is to know in exactly what part of the bladder the stone tends to lie and in exactly what part of the bladder the beak of the lithotrite is. The practiced physician learns these things from the very first touch, and appreciates also the general contour of the bladder, its trabeculæ, saccules, etc. But the neophyte's only hope is to go slowly. He learns by the first grasp whether the stone lies to the right or to the left, whether near the neck of the bladder or far from it, and, accordingly, he can check his tendency to wander fruitlessly about by directing the blades of his instrument to this spot where the larger fragments are almost sure to be found, or by closing the lithotrite and using it as a searcher. It is scarcely necessary to say that the lithotrite has no wider range of motion than any other urethral instrument. It may be pushed forward and backward; it may be rotated; the shaft may be elevated or depressed a few degrees, but any turn of the shaft toward the right or the left is quite unnecessary, and likely to be dangerous. It is also to be noted that when the lithotrite is touching the base of the bladder it is opened by pulling the male blade forward, while to open it near the neck of the bladder the female blade is pushed backward. It is in general easier and safer to crush the stone near the neck of the bladder, and the instinctive tendency of the beginner to let his instrument gravitate toward the fundus must be overcome.

When a fragment is peculiarly elusive it usually lies in some kind of a pocket, from which it may be extracted by rolling the patient to one side or the other, putting him in the Trendelenburg position, or simply by depressing the floor of the bladder with the open lithotrite and imparting a succession of short, sharp jars to the patient's pelvis until the stone rolls into the grasp of the instrument.

After-treatment.—The course of water and hexamethylenamin is resumed as soon as possible after operation. If the bladder is very irri-

table a catheter may be tied in, but, as a rule, I prefer to let the patient urinate spontaneously, and only use a catheter in case of retention, and for a routine boric-acid wash twice a day. The irritability of the bladder the first few days may be controlled by morphin or by opium suppositories. Nitrate-of-silver injections or instillations afford great relief toward the end of the first week, but they are irritating during the first days.

It is unwise to let a patient—especially an old man—get up before four days have passed. He may seem well before that time, but his soreness may return and mild cystitis occur if he gets up too soon. I have in exceptional instances turned my patient out on the second day. I have indeed operated in my office several times under local anesthesia—and with no anesthetic in the case of small stone—but this again only in exceptional cases.

The after-treatment cannot be considered complete until the patient has been searched for stone one month after the operation, nor can any assurance be given that no fragment has been left behind until this search has been performed.

For this purpose the cystoscope should be employed.

Complications.—*Complications during Operation.*—The difficulties most commonly encountered in finding and crushing the stone have already been noticed. It may happen that the stone cannot be crushed, either on account of its great size or hardness, or on account of its position in a small-mouthed pocket. In any such case litholapaxy must be given up and suprapubic lithotomy performed immediately if possible. Clogging is quite impossible with a fenestrated lithotrite.

The complication most to be feared is inability to crush and remove the last fragment. If there is much sacculation or trabeculation of the bladder the last fragment is most elusive, and, rather than protract the operation unduly, it may be preferable to postpone its completion to another time. This concession can only be made with reluctance, since it forfeits the most brilliant advantage of litholapaxy—viz., the entire removal of the stone. Spasm of the bladder is a most annoying feature of operations under local anesthesia, but is rarely troublesome when a general anesthetic is employed.

Postoperative Complications.—After litholapaxy all the complications may occur that are met with after the various operations upon the urinary tract, from catheterism upward: retention, hemorrhage, mild or pernicious urethral fever, cystitis, prostatic abscess, epididymitis, or even the graver complications, suppression, surgical kidney (pyelonephritis), possibly even pyemia and septicemia; but, as a rule, a careful operation has no sequence but a little temporary discomfort for a week or less, followed by a cure.

Impacted fragments in the urethra, one of the horrors of old-fashioned lithotrity, should never occur with this operation. If the bladder is left empty of fragments such a complication is obviously impossible. Should it ever occur, the foreign body may be pushed back into the bladder or removed from the urethra by one of the methods already alluded to (p. 446). Hemorrhage is usually checked by the postoperative wash. Should it be profuse and the bladder fill with clots, the easiest way to remove these is by the aspirator, using a small tube. Cystotomy is the last resort.

The commonest postoperative complications are those relating to the prostate and to the kidneys. Epididymitis and abscess of the prostate are complications of a litholapaxy roughly performed. But the most skilled hand cannot always prevent prolonged postoperative prostatic catarrh, which may make both patient and surgeon wish that section had been performed. Less frequent, but far more dangerous, are the kidney complications. It is the old man with long-standing cystitis—perhaps one who has been often operated upon for stone—whose kidneys, worn out by retention and infection, are most likely to succumb. Lithotomy is much better suited to such cases, since the atonied, pouched bladder makes litholapaxy a very trying operation, while section is quicker, provides better drainage, and permits removal of the prostatic obstruction causing the recurring stone. But it is vain to argue with these men; they are satisfied with the relief they are accustomed to obtain from litholapaxy and cannot be made to see its lurking dangers.

Relapse after litholapaxy may occur from one of three causes: (1) A fragment may be left by the operator; (2) a new stone may come down from the kidney; or (3) phosphatic reaccumulation may occur in a catarrhal bladder. The first contingency is guarded against by the thorough search at the end of operation, and again a month later. The second is prevented by the hygienic rules already laid down, or is foreseen by establishing the presence of kidney stone. The third can be prevented only by lithotomy, and not always by that operation. Freyer states that he has had no relapses after litholapaxy, although he has performed it 610 times.

Yet I have removed by litholapaxy a stone that formed after one of his suprapubic prostatectomies.

I cannot pretend to have equaled his record, nor, I believe, can any other surgeon, but I am sure that litholapaxy, if properly performed, exposes the patient to no more danger of recurrence than does lithotomy, except inasmuch as lithotomy enables the surgeon to deal with obstructive conditions which cannot be reached by litholapaxy.

OTHER INTRAVESICAL OPERATIONS

Many types of intravesical operating cystoscopes have been invented by ingenious surgeons. But these have accomplished little more than the occasional picking of a stone from the ureter orifice.

Of Nitze's operating cystoscope we can only say that the wonderful cures claimed for it by its inventor have not been confirmed by anyone else. Intravesical operations, especially for bladder tumor, are distinctly "in the future."

CHAPTER LXXXVIII

OPERATIONS FOR THE CURE OF URINARY FISTULÆ AND DEFECTS OF THE URETHRA

URINARY FISTULÆ

Treatment of fistulæ discharging urine, whether they connect with the kidney, the ureter, the bladder, or the urethra, is primarily expectant. If retention is not present, most fistulæ will heal of their own accord, unless there is considerable loss of tissue. If there is retention, whether due to kinking or obstruction of the ureter, or to urethral stricture or prostatic obstruction, this must, of course, be removed before the reëstablishment of urinary flow through the natural passages can be looked for.

Among the injections employed to encourage the healing of urinary fistulæ, the 25-per-cent ethereal solution of hydrogen-peroxid is generally the most useful; but, if all else fails, operation may be required to heal the fistula.

The types of fistulæ requiring operation fall under the following heads:

Renal fistula.	Vesicovaginal and vesico-uterine fistula.
Hypogastric vesical fistula.	Urethro-rectal fistula.
Vesico-intestinal fistula.	Urethro-perineal fistula.
Penile fistula.	

The surgical principle at the bottom of almost all the operations undertaken is the separation of the visceral and cutaneous ends of the fistula, suture of the visceral orifice (or, if the fistula is between two viscera, suture of both visceral orifices), and the interposition between the two ends of the fistulous tract of a thick body of normal tissues after the tract itself has been excised. The treatment of renal fistula forms almost the only exception to this rule.

Renal Fistula

Urinary fistula in the loin, following operation upon the kidney, will usually heal unless there is obstruction to the normal urinary out-

flow, or unless there remains a pyonephrotic kidney or a tubercular kidney or ureter within the loin. The operations for the relief of these fistulæ consist, therefore, in the relief of urethral or renal retention, if these be present, or in the removal of the disorganized kidney. Previous to operation an attempt to encourage the closing of the fistula by the prolonged retention of a ureteral catheter should be attempted if this is practicable.

Removal of ureteral obstructions has already been discussed (p. 853). Nephrectomy of an old pyonephrotic kidney which has long been fistulous is one of the most difficult and dangerous operations of urinary surgery. The operation is conducted upon the usual lines for nephrectomy, but the kidney may be found so bound down in a mass of adhesions that it is impossible to determine what is kidney and what scar, and still more impossible to separate the organ from its fibrous bed.

Basing his practice upon the researches of Hermann and Nicolai, Holt [1] has suggested and practiced ligature of the renal pedicle for the purpose of avoiding the difficulties of this operation. He incises the internal abdominal wall along the outer edge of the rectus, pushes the large and small intestines toward the median line, and incises the peritoneum over the renal vessels to the outer side of the mesocolon. The retroperitoneal tissues are then separated toward the vertebral column until the renal artery and vein are discovered. If the adhesions are so dense as to make this separation difficult, it may be preferable to incise the posterior peritoneum internal to the colon, and proceed with the ligature of the renal vessels in the space between the colic arteries. The artery and veins are tied separately, and a careful search made to be sure that no accessory renal vessel has been overlooked. The wound is then closed in the usual manner.

Hypogastric Vesical Fistula

Hypogastric vesical fistula will usually close if the external orifice is kept widely open so as to prohibit pocketing, and if urethral obstruction is relieved. The retained urethral catheter may be of assistance. Even though the fistula remains open for many weeks or opens and closes intermittently, the surgeon should not be too hasty in suggesting operative relief, but should reserve this for cases that have proven absolutely rebellious for months.

The operation should consist in excision of the fistulous tract, freeing of the wall of the bladder, and closure of the fistulous orifice in the bladder wall by mattress sutures reënforced, if possible, by a layer of Lembert sutures. The abdominal wound may be left open, or the mus-

[1] *Medical Record*, 1907, June 22.

cles may be caught together over a small drain. The retained urethral catheter should be employed, if possible.

Vesico-intestinal Fistula

The operation for vesico-intestinal fistula consists in median abdominal section, isolation of the loop of intestine adherent to the bladder (a large ureter catheter placed in the fistula may be of assistance), emptying and clamping of the gut, separation of the gut from the bladder, closure of the gut by enterorrhaphy or end-to-end anastomosis, and closure of the bladder orifice by mattress suture. The retained urethral catheter and drainage to the point of suture in the bladder are again necessary.

Vesicovaginal and Vesico-uterine Fistula

Vaginal Fistula.—The patient is placed in the lithotomy position and the vaginal orifice of the fistula exposed and liberated by a circular incision. This incision is carried up about the fistula until the mucous membrane has been freed up to the bladder. The fistula is then turned inside out, as it were, and caught by one or two submucous sutures. The vesicovaginal septum is then sutured with chromic gut, and afterward the vaginal wall sutured over all with simple catgut. The bladder should be drained by a retained catheter.

Vesico-uterine Fistula.—The closure of vesico-uterine fistula is extremely difficult. An attempt at closure may be made by excising the fistulous tract and then suturing through and through exclusive of the bladder mucous membrane. If this fails, an attempt may be made to suture in layers, as above described; or the mucous membrane may be cut from the uterine cervix and sutures passed through this for the purpose of closing it, while leaving the fistula in communication with the uterus. If this is done, the fistula must, of course, be large enough to permit the passage of the menstrual flow.

Urethro-rectal Fistula

The fistula is reached by the bilateral or curved prerectal perineal incision. If it is of small dimensions, it may then be occluded by freshening its interior and simply throwing a catgut ligature about it; but if, as is usually the case, it is too short and wide for this treatment, it must be freely divided close to the urethra. The rectum is then closed with submucous sutures of chromic gut, the urethral orifice closed in like manner, the edges of the levator ani sought for and brought together as in Young's operation for prostatectomy, and ample drainage provided for the external wound, but very little drainage in the depth.

The drainage is removed in forty-eight hours and the external wound permitted to granulate.

In difficult cases, this operation will only succeed if preliminary suprapubic cystotomy is done.

As routine practice, it is best to place a retained catheter in the urethra for the first week.

Alexander has suggested that the proper application of pads of gauze, well greased with vaselin, high up in the wound will deflect the flow of urine from the sutured rectum and obviate the necessity of closing the urethra, which is, therefore, permitted to heal by granulation.

Rotation of the rectum, in order to place its fistulous orifice at a point not opposite to the urinary channels, has been practiced by Fuller and others, but is of doubtful value.

If the urethro-rectal fistula is so large that the above operation is impossible, the fistula may be changed into a urethro-perineal one by Albarran's procedure of freeing the rectum by a posterior, U-shaped incision carried up to beyond the point of fistula. Lateral incisions are then made in the rectal wall and carried forward to meet in a V above the fistulous orifice on the anterior wall of the rectum. The two edges of this V are then united so as to leave a urethral channel running to the perineum. The posterior edges of the V were also then united, thus isolating the rectum from the new urethro-perineal fistula. After healing had taken place, the urethro-perineal fistula is closed by a secondary operation.

Urethro-perineal Fistula

Perineal urethral fistulæ will almost always close, unless they are tuberculous or cancerous, by the lapse of time, if the caliber of the urethra is kept open by sounds. Injection of ethereal peroxid is of great assistance. Albarran suggests that cauterization with the actual cautery is useful. If these means fail, the fistula may be closed by free dissection of the perineum, excision of the scar, suture of the urethra around a retained catheter, over which is drawn a thick layer of the urethral and perineal muscles, and closure of the skin. Or Guyon's flaps may be employed, as after fistulization for complicated traumatic stricture (see below).

Penile Fistula

Penile fistulæ are to be treated along the general lines applicable to perineal fistulæ. The methods commonly described for closure of penile fistula are three:

Simple suture of the fistula after excision,
Lateral flap method.
Posterior flap method,

The lateral flap method consists in surrounding the orifice of the fistula by a rectangular incision, the edges of which are turned in and sutured. A rectangular flap is then made to one side and drawn across the raw space left by the inturning of the skin about the fistula. If the fistula is too large to be closed by this method, the posterior and lateral flap incision of Pasteau may be employed. The edges of the fistula are freshened and two lateral flaps turned back. A third flap is then cut about 1 cm. posterior to the lateral flaps, its apex about 3 cm. farther down on the penis or scrotum, its base at the fistula. This flap is then freed and turned up over the fistula and carried beyond this under the skin in front, where it is held by two sutures. This flap forms the new urethral mucous membrane. The two lateral flaps are then drawn together across the raw surface of the posterior flap and the space left where the posterior flap was turned up is closed by lateral sutures.

RESECTION OF THE URETHRA

Resection of the urethra is described by Albarran under four heads:

Resection for traumatic and limited inflammatory strictures.
Resection for complicated traumatic strictures.
Resection for stricture complicated by infiltration.
Resection for rupture of the urethra.

Resection for Traumatic and Limited Inflammatory Strictures

A sound is introduced down to the stricture, median perineal section is performed, and the urethra divided in front of the stricture. The divided urethra is then drawn down and the dense stricture mass excised, leaving the two ends of the urethra separated by a greater or less distance. These urethral ends are then freed sufficiently to bring them together, and they are sutured with catgut, the sutures through the superior wall being knotted inside the canal, the others outside. A retained catheter may be placed in the urethra, but it is preferable to insert a small perineal tube through a longitudinal incision in the floor of the urethra posterior to the stricture.

In many instances it is possible to make the resection incomplete, removing a large mass of scar tissue, but leaving a bridge at the roof of the urethra. In order to insure the patency of the canal, it is best, in suturing it, to split the floor and to suture this longitudinal incision transversely so as to enlarge the urethral caliber.[1]

[1] Hugh Cabot has described this operation in detail, insisting especially on the possibility of extensively mobilizing the urethra anterior to the stricture for the purpose of closing the gap.

Resection for Complicated Traumatic Strictures

If the stricture is very wide or complicated by considerable periurethritis, the operation above described may be impracticable. In this event, the best procedure to follow is probably that of Pasteau. At a first operation a urethro-perineal fistula is deliberately made, either by longitudinal incision of the urethra and suture of its edges to the lateral edges of the skin wound, or, if the two ends of the urethra are widely separated, by suture of each of these extremities to the skin. The fistula thus produced is closed at a second operation by Guyon's lateral flaps. One rectangular flap is made to the right of the fistula, with its base toward the fistula and its free border to the right. This is turned in and sutured so as to close in the urethra. To the left of the urethra a much longer rectangular flap is then made, with its edge toward the urethra and its base lateral. This is drawn over to cover in the defect made by turning in the first flap.

Heteroplastic Operations

Mensell, Woelfler, and my father have closed in large defects of the urethra by implanting a piece of mucous membrane taken from the inner layer of the prepuce. Lapiejko [1] has reviewed the subject and reported three cases in which he employed mucous membrane taken from the lip.

[1] *Guyon's Annales*, 1894, p. 1.

CHAPTER LXXXIX

VARIOUS OPERATIONS UPON THE URETHRA AND BLADDER

MEATOTOMY

Antisepsis.—The tip of the penis should be well cleansed with soap and water and bichlorid, and the terminal portions of the anterior urethra irrigated with a 1:5,000 solution of the latter.

Anesthesia.—A minute bunch of cocain crystals, or a fragment of a cocain tablet is inserted within the meatus and dissolved by instilling upon this, with a medicine dropper, a few drops of 1:1,000 adrenalin solution.

Anesthesia is completed within five minutes, by which time a distinct blanching of the tip of the penis is noticed.

The Operation.—A blunt-pointed, straight bistoury is introduced into the urethra, the floor of which is cut by an outward sweep of the instrument. With the bulbous bougie the patency of the canal is then tested, and any bands that require further division are cut. If the meatus internus is narrow, this may be cut with the bistoury, although some surgeons prefer to use the urethrotome for this purpose. All incisions should be made upon the floor.

OPERATION FOR RUPTURE OF THE URETHRA

When the urethra is ruptured in its penile portion, the indwelling catheter will usually prevent complications, though if large hematoma occurs this should be incised, and through this incision the urethral walls may be sutured. For perineal rupture, immediate median perineal section should be performed. If a slight, or partial, rupture is encountered, clots are cleared away and a perineal tube inserted.

If the rupture is complete, it may be quite difficult to find the posterior segment, though I have always succeeded in doing this by identifying with the finger the position of the triangular ligament, irrigating the wound and identifying therein the urethra, which sometimes lies quite loose—a thin-walled, flaccid tube. If this expedient should fail, however, bilateral incision and exposure of the membranous urethra and prostate usually discloses the ruptured extremity. Retrograde catheterism is a last resort.

If there is not too much loss of tissue, the torn fragments should be approximated by one or two chromic gut sutures on the roof, and a perineal tube inserted; but if there is too much loss of tissue to permit this, no plastic operation should be attempted, but the tube simply inserted, and after three or four days replaced by the indwelling catheter, which is introduced into the meatus and out through the perineal wound, then in from the perineal wound and into the bladder. If fistula persists this requires secondary operation (p. 918).

OPERATIONS FOR HYPOSPADIAS

Beck's Operation.—This consists in liberating the urethra, bringing it forward and suturing it to an orifice punched through the glans. The urethra must be freed well back and sutured to the apex of the glans

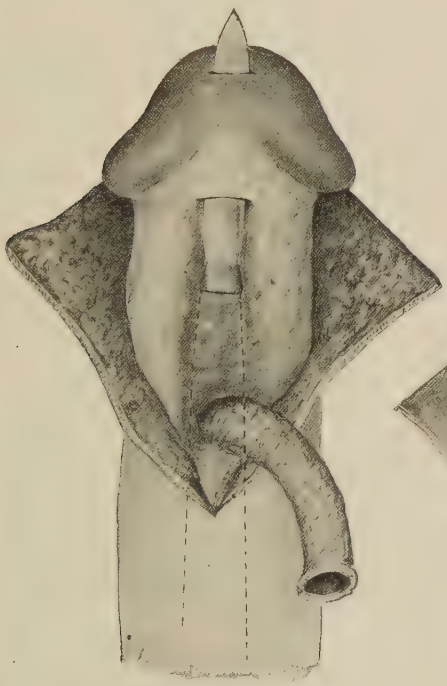

FIG. 185.—BECK'S OPERATION FOR BALANITIC HYPOSPADIAS. Liberation of the urethra—puncture of the glans.

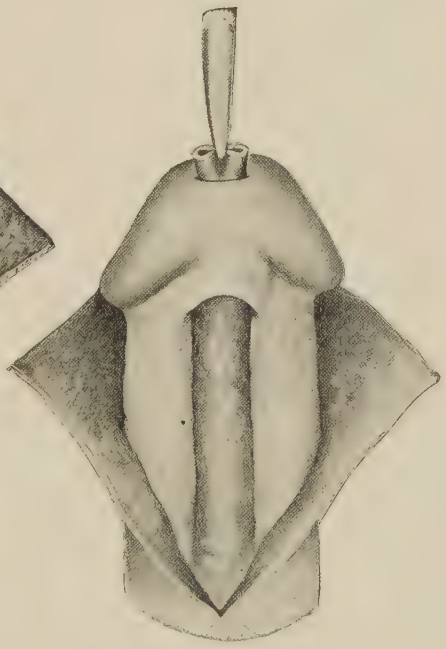

FIG. 186.—BECK'S OPERATION FOR BALANITIC HYPOSPADIAS. The urethra drawn through the glans.

to prevent incurvation (Figs. 185, 186, 187). This is a much simpler expedient than Duplay's, and is commendable, since the formation of a fistula—which is the bane of the older operation—is avoided, and the sutures usually hold.

Operation for Penile Hypospadias.—For *penile hypospadias* the operations are many and various. Certain preliminary steps are necessary in almost all cases.

First, *the penis must be freed from its scrotal adhesions.* If these are slight, a transverse incision through the peno-scrotal frenum will, when sutured in a longitudinal direction, suffice to free the organ. But if the penis is deeply buried in the scrotum the integument of the former must be derived from the latter with regard only to covering in the penis; the scrotum will, by virtue of its looseness, adapt itself to the loss of almost any amount of skin.

Fig. 187.—Beck's Operation for Balanitic Hypospadias. Suture.

Secondly, the *incurvation of the body of the penis often demands attention.* This may be corrected through the liberating incision. A transverse incision is carefully made through the whole thickness of the sheath of the corpora cavernosa on its under surface, care being taken to avoid the erectile tissue. This is usually sufficient to permit straightening the penis. If not, the intercavernous septum may require division down to the dorsum. Then the penis is forcibly straightened and snugly bandaged about a slight splint in an overextended position to prevent recontracture. I can vouch from personal experience for the satisfactory results obtainable by this somewhat violent procedure. If the penis is kept straight until entirely healed it may be anticipated that subsequent erections will be complete and direct.

Finally, comes the most delicate part of the treatment—the extension, namely, of the urethra to its proper length. Great ingenuity has been displayed in the formation of the new canal. The operation of Duplay is preferred by most surgeons, though the methods of Thiersch [1] (an adaptation of his operation for epispadias), Dieffenbach,[2] Dolbeau,[3] Laurent,[4] and Van Hook [5] also deserve mention. In each of these the lining membrane of the new canal is derived, in one way or another, by flaps turned in from the adjoining regions. That each has been devised to supplement the older ones is an evidence—to which the surgeon who has tried any will certainly testify—of how rarely they succeed and how utterly baffling they all are.

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[1] *Arch. für Heilk.*, 1868, x, 20.

[2] *Gaz. méd. de Paris*, 1837, 156.

[3] "De l'épispadias . . . et son traitement," Paris, 1861.

[4] *Bull. de l'acad. de méd. belg.*, 1895, iv, ix, 685.

[5] Cf. Mayo, *Jour. Am. Med. Ass'n*, 1901, xxxvi, 1157.

I prefer, and have employed with one complete success and one partial failure, the Rochet-Nové-Josserand operation, which avoids many of the difficulties encountered in other procedures.

Nové-Josserand's Operation.—Through a transverse incision 2 cm. long and just in front of the hypospadic meatus, a stout probe is introduced and passed forward along the under surface of the penis, in the subcutaneous connective tissue, until it reaches the base of the glans,

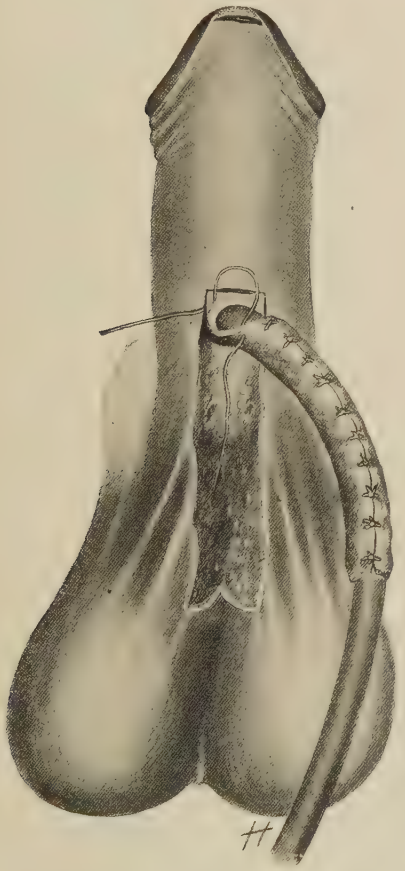

Fig. 188.—Rochet's Modified Nové-Josserand Operation for Hypospadias. The flaps are cut, the catheter introduced, the scrotal flap sutured around it.

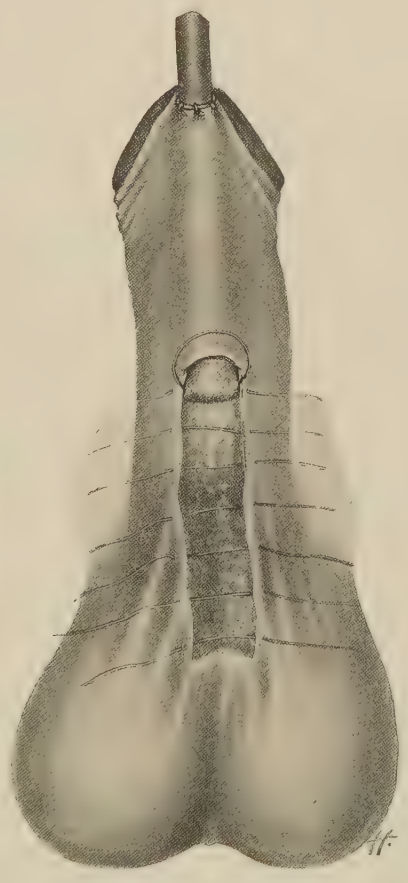

Fig. 189.—Rochet's Modified Nové-Josserand Operation for Hypospadias. The final sutures.

elevating the skin from the entire under surface of the penis. The anterior orifice of the canal is then formed by slitting up the under surface of the glans, or by puncturing it with a trocar. To obtain an epithelial lining for this canal—and herein consists the originality of the opera-

tion—an Ollier [1] skin-graft, 4 cm. wide and considerably longer than the intended canal, is taken from the inner side of the thigh, where there are no hairs, and wrapped, inside out, around a woven catheter, 21 French in size, and held in place by a ligature at each end and one or two sutures, all of 00 catgut. (Rochet [2] employs, instead of the Ollier graft, a flap taken from the scrotum, with its base at the abnormal urethral orifice. This device eliminates the fistula between the old urethra and the new (Figs. 188, 189)). The catheter thus covered is then inserted into the canal, and when the graft is in place the anterior ligature is cut and removed, and the edge of the graft sutured to the glans penis. The catheter is then cut off short so that each end barely protrudes from the canal, and a snug dressing is applied with the penis held in the erect position. A retained catheter is used to draw off the urine. (In the Rochet operation the catheter around which the graft is wrapped is used as a retained catheter.) On the eighth day the posterior ligature is cut and the catheter removed. Five days later the daily passage of sounds is begun and continued for three weeks.

The Nové-Josserand operation has been still further modified by its originator,[3] as follows:

As a first step, three operative procedures are performed:

(1) The incurvation is corrected by incision of the fibrous envelopes of the corpora cavernosa.

(2) The bulbous urethra is incised for a distance of at least 4 cm. and sutured to the skin of the perineum, thus forming a perineal urethrostomy.

(3) The edges of the hypospadic meatus are incised and sutured to each other, so as to close its orifice permanently.

Six or eight weeks later the second operation is performed, as follows:

(1) The meatus is reopened by a simple longitudinal incision.

(2) By means of a trocar a canal is bored in the subcutaneous tissues of the penis from the hypospadic meatus to the glans penis. This canal is sufficiently dilated to admit a No. 20 French sound. It is then compressed for a few moments in order to check the bleeding.

(3) A graft consisting of the whole thickness of the true skin, half again as long as the new urethra and about 4 cm. wide, is taken from the antero-external surface of the thigh. This is sutured, skin side inward, about a soft-rubber catheter, size 18 French. Three fine catgut sutures are employed.

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[1] The Ollier graft differs from the Thiersch graft in that it is made as thick as possible without including any of the subcutaneous tissue, instead of—as in the Thiersch method—as thin as possible.

[2] *Guyon's Annales*, 1900, xviii, 648.

[3] *Arch. gen. de Chir.*, 1909, No. 25.

(4) A fine dressing forceps is introduced from before backward through the newly tunneled canal and withdrawn, carrying the catheter and graft with it. The graft should extend well beyond each end of the new canal. The catheter is fixed in place by a silk suture attaching it to the glans.

On the eighth day a silk suture is tied to the end of the catheter and this is gently withdrawn, carrying the silk suture into the new canal, where it is left. Thereafter the new canal is gently irrigated once a day with boric-acid solution.

On the fourth day after removal of the catheter, the silk suture is tied to the tip of a No. 12 French bougie, which is thus gently drawn through the new canal and withdrawn again, leaving the silk thread still in place. This sounding is repeated with instruments no larger than No. 15 French twice a week for two months, the silk suture being employed as a guide the first three or four times. Thereafter dilatation is carried up to No. 20 French, and if there is any difficulty in this operation the canal is widened by urethrotomy upon the roof. About two months more are required to obtain a canal of sufficient caliber, and during this time the fistula at the junction of the new and old urethras may be expected to close. When this has occurred, the perineal fistula is closed by a third operation. The mucous membrane of the urethra is cut away from its attachment to the skin and freely separated from the intervening tissues. The urethra itself is sutured and the soft parts sutured over it.

OPERATIONS FOR EPISPADIAS

The cure of epispadias requires two operations:

1. Closure of the sphincter.
2. Formation of a new canal.

The Sphincter.—Trendelenburg states that the sphincter may be adequately tightened by excision of a broad wedge-shaped piece of the orifice and suture.

Formation of a New Canal.—This may be done by a flap operation or by the Nové-Josserand procedure.

OPERATIONS FOR EXSTROPHY

Three varieties of operation may be recognized:

1. Obliteration of the bladder.
2. The formation of a new bladder.
3. Diversion of the stream of urine.

With each of these the radical cure of hernia may be combined.

1. **Obliteration of the Bladder** (Sonnenberg [1]).—This operation attempts but little. The mucous membrane of the bladder, or the whole bladder wall, is removed, and some attempt is made by skin-grafting or flap-raising to bring the abdominal wall together and so to remove the large raw surface of the bladder and to substitute scar or skin in its place. The ureters, with the mucous membrane around their orifices, are displaced downward and sutured to the end of the penile groove, which may be closed previously or simultaneously by one of the operations for epispadias. Thus the object of the operation is to improve the patient's condition to the extent of leaving him with a manageable incontinence by removing the sore and stinking bladder. The operation, though by no means simple or always successful, has no immediate mortality.

2. **The Formation of a New Bladder** (Autoplastic Method).—Operations of this class should not be performed on children younger than five. This operation is the ideal one, but it is an ideal that has not been realized in practice, for the few patients who can be classed as satisfactory retain their urine only for some twenty minutes to an hour, and even these are but a small proportion of the unfortunates who, after their three, four, five, or more operations, have proved total failures. Several improvements in the technic have been recently suggested, but until some one shall produce a sphincter for the bladder the patient's capacity to hold his urine after operation will be entirely a matter of chance.

The operations may be described as—

a. Suture of the bladder itself.

b. The flap operation.

c. Closing the symphysis.

As a preliminary to operation, hexamethylenamin should be administered to keep the urine sweet, and ureteral catheters should be introduced to keep the wound dry.

The ideal method theoretically is to dissect up the bladder wall, to turn it over, and to suture it so as practically to form a new bladder. There are two causes of failure. In the first place the bladder is so contracted that there is scarcely any tissue to work on. Pousson,[2] in order to overcome this, boldly enters the peritoneal cavity, inverting the bladder, peritoneal coat and all, and then closing off the general peritoneal cavity (but he reports only one case, and that a failure). In the second place, in spite of ureteral catheters and constant changes of dressings, urine gets into the wound, which granulates instead of healing, with the result that the sutures tear out.

The flap operation has been developed by the ingenuity of Roux,

[1] *Berlin. klin. Wochenschr.*, 1882, xix, 471.

[2] *Guyon's Annales*, 1898, xvi, 1223.

Thiersch, Pancoast, Ayres, Holmes, and many others. (Cf. Pousson.) One or two flaps taken from the surrounding skin are turned in to form the anterior wall of the bladder, and the raw surface thus left is covered in as far as possible by other flaps. This operation often succeeds after many partial failures, but the hairs that ultimately grow from the inverted skin become incrusted with phosphates, and the patient finds his partial relief not worth the having. Recent experimenters have suggested filling in the gap with a segment of the gut (Tizzoni and Poggi, Enderlin[1]), and this operation has been performed once successfully on a man by Rutkowski,[2] whose patient, eight weeks after operation, could retain 25 c.c. of urine. The defect in the bladder wall in this case was not a large one. The gut used was the ileum, which was left attached to its mesentery. Manifestly such an operation is not without its dangers both immediate and remote. A simpler procedure, suggested by Mundel,[3] consists of elevating a flap from the abdominal wall and grafting to its raw surface the bladder wall of a sheep. After this graft has adhered it is swung over the bladder.

Attempts at closing the symphysis in order to diminish the gap to be covered over, and at the same time to attempt the formation of a sphincter, have not been very successful. Trendelenburg applies a belt, hoping by its pressure to approximate the bones, and if this fails he opens the sacro-iliac synchondrosis on each side. This operation is not applicable to children over eight years of age, and its results have been quite universally unsatisfactory, though Delagénière reports a case in which, after seven supplementary operations, he obtained a radical cure and a satisfactory sphincter. Berg has employed osteotomy of both iliac bones with rather better success. Not enough work has been done along any of these osteoplastic lines for broad conclusions to be laid down as to their results.

3. **Diversion of the stream of urine,** by means of ureteral implantation into the loin or the bowel, has long been a favorite but dangerous operation (p. 860).

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[1] *Deutsche Zeitschr. f. Chir.*, 1900, lv, 50. [2] *Centralbl. f. Chir.*, 1899, xxvi, 473.
[3] *Annals of Surgery*, 1899, xxx, 715.

CHAPTER XC

OPERATIONS UPON THE SCROTUM AND ITS CONTENTS

Antiseptic Preparation.—Since the skin of the scrotum is extremely sensitive, it is not to be forgotten that the preliminary soap poultice should be kept on no longer than four hours, and the subsequent bichlorid dressing made no stronger than 1:10,000.

Anesthesia.—In the absence of acute inflammation, all operations upon the scrotum and its contents may be performed under infiltration anesthesia.

The infiltration is readily performed if the skin is made tense by grasping it firmly with two fingers in front and one behind. The line of incision should usually be vertical.

After the skin has been infiltrated and incised, no further anesthesia is usually required until the tissues of the cord proper are reached; thus, in varicocele operations, the sheath of the veins is opened and then the loose tissues about the veins infiltrated at several points high up with 0.2-per-cent cocain solution, after which all manipulations except ligation of the body of the veins is painless. But after the ligature has been thrown around the mass of veins and loosely tied, the hypodermic needle should be plunged boldly into the veins *below* the point of ligature and about 1 c.c. of the solution injected. Since this injection is made below the ligature, no harm can come from puncture of a vein; and the solution, rapidly infiltrating along the fascial planes, anesthetizes the tissues above and around the ligature, so that the ligature can be painlessly tied three minutes after injection.

For operation upon the testicle, the whole cord must be similarly infiltrated, though here care must be taken not to puncture a vessel. Inasmuch as the course of the nerve filaments in the cord is somewhat irregular, no more precise rule can be given for infiltration.

Postoperative Dressing.—Since the only dangers in scrotal operations are hemorrhage and infection due to hemorrhage, all operations in this region should be conducted with the greatest regard for hemostasis. Absolutely every bleeding point should be controlled before the wound is sutured but, even if this precaution is taken, some oozing is likely to follow unless the scrotum is controlled in a tight bandage.

Of the various methods of bandaging, I know none to equal the adhesive-plaster dressing. A broad strip of adhesive plaster is placed under the scrotum in the familiar manner across the thighs close up against the perineum. The whole scrotum is covered with no more than two layers of gauze, and the operative wound protected by the smallest possible gauze pad. A piece of adhesive plaster about 4 inches broad is then affixed tightly from the iliac region of one side across the front of the scrotum to the opposite thigh, the band passing close against the peno-scrotal angle, and the testicle being held down so as to be pressed downward between the two bands of adhesive plaster.

If both sides of the scrotum have been operated upon, a band is placed on the opposite side with similar precautions. But if only one side of the scrotum has been opened, the testicle upon the other side may be disregarded and allowed to slip toward the upper end of the band, if that seems more comfortable. These bands of adhesive plaster are then reënforced by one or two narrower strips, after which the bridge below the scrotum is somewhat depressed, and gauze is stuffed into the corners between the scrotum and the thighs. This dressing should be left in place for at least three days, or, if removed, should be replaced. On the fourth day the adhesive plaster may be replaced by a Curling bandage or a suspensory.

OPERATIONS UPON THE SCROTUM

Inflammatory, fistulous, and gangrenous affections of the scrotum require bold, free incision and excision. The surgeon should not have any misgivings as to the length or variety of his incisions, since these close with incredible rapidity. Even though the testicles are laid entirely bare by incision of gangrenous areas of skin, the wound closes with extreme rapidity and secondary skin-grafting is scarcely ever necessary.

Resection of the uninflamed scrotum, which may be required for cosmetic purposes after the removal of large tumors, hydroceles, or varicoceles, is, generally speaking, best performed by transverse excision of the skin. The redundant portions of the scrotum are caught with a long, curved intestinal clamp, and the skin protruding below the clamp cut away. The incision may then be closed by suture before removal of the clamp, though hemostasis is more likely to be effectively accomplished if the clamp is first removed, the bleeding points in the fascia caught and tied, and the skin then sutured.

VASOTOMY

The vas deferens is identified by grasping the tissues of the spermatic cord between the thumb and index finger and permitting them to

slip to and fro from the grasp until the thick, cordlike vas is distinctly appreciated. This is usually to the inner side of most of the other structures. The scrotum is then thrown forward and the vas readily brought under the skin posteriorly. The point at which the vas shall be most readily accessible having thus been identified, it is dropped and this point is anesthetized by infiltration for about 2 cm. The vas is then brought back under the infiltrated area and pressed against it. The skin and underlying tissues are divided and the vas brought into the wound, where it may be tied or opened, or a piece of it excised. The small skin-wound is then closed by suture, care being taken to include all bleeding points.

Belfield's operation for drainage of the vas deferens and irrigation of its ampulla is performed in a similar manner; but when the vas is divided a fine silk suture is passed into the wall and out through the lumen of the upper segment, then in from the lumen and out through the wall of the lower segment. This suture is tied loosely, and after the irrigations have been performed to the satisfaction of the operator, it is tied tightly in the hope that the vas may reunite patent. Such reunion would seem improbable, yet it has been verified in several cases, though in the majority of cases it probably fails to occur. The "unilateral sterility" which is likely to result from this operation is its chief objection.

The vas may be tied off subcutaneously in the same manner as the veins are tied in the subcutaneous operation for varicocele.

OPERATIONS FOR VARICOCELE

Subcutaneous Ligation.—The instruments required are: (1) a rather large straight needle in a solid handle, the eye of which is closed on the Reverdin principle, and kept closed by a spring in the handle (Fig. 190), and (2) a spool of heavy (No. 12) twisted white silk. The patient is prepared in the usual manner. The surgeon's hands and instruments are sterilized. By means of a 1-per-cent solution of cocain an area 1 cm. in diameter is anesthetized in a place selected in the upper part of the front of the scrotum, and a similar area in the back. The needle is then armed with a strand of silk 25 cm. long (its eye keeps closed by the automatic action of the spring).

The surgeon grasps the scrotum with the thumb and index finger of his left hand. By drawing the fingers slowly toward the patient's right side the spermatic cord is allowed to slip piecemeal from the grasp. First the flabby veins of the plexus slip through in a wormlike bundle, then, after a slight interval, the solitary thick vas, followed perhaps by one or two more veins. This maneuver is repeated once or twice until the surgeon is absolutely sure that he has identified the interval be-

tween the vas and the plexus. Then, holding the veins well to the outer side, and pinching the scrotum tightly to be sure that no veins elude his grasp, the needle is plunged into the anesthetized area close to the tip of the thumb. If the skin in front and behind has been anesthetized this maneuver is quite painless. When the needle emerges from the back of the scrotum (Fig. 191), its eye is opened by retracting the button in the handle, the silk loop disengaged from it, and *one end* of the silk pulled through and out of the scrotum posteriorly. Now the scrotum is traversed between the bundle of veins and the vas deferens, independently by the needle and a single strand of silk.

Fig. 190.—Varicocele Needle.

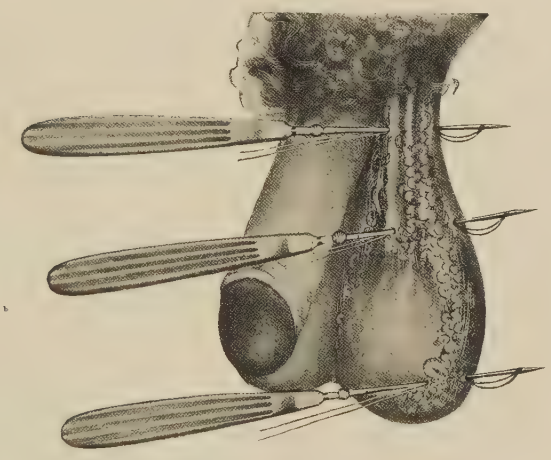

Fig. 191.—Subcutaneous Ligature of Varicocele.

The needle, with its eye tightly closed but empty of thread, is now withdrawn partly, but not from the point of anterior puncture, and the veins are allowed to slip back toward the vas. As soon as this occurs the needle, which has not been withdrawn entirely, is again advanced outside of the veins close under the dartos and carefully made to emerge behind at the exact point from which the silk is protruding. The bundle of veins now lies between the strand of silk and the needle. The eye of the latter is again opened, the silk engaged in it and drawn through the scrotum and out of the anterior opening. A little piece of dartos will always be included in the silk at the point of posterior puncture. This is torn away by pulling the scrotum backward while making strong traction upon the loop of silk. The veins are thus caught in a loop of silk, which is tied firmly and tightly in a triple knot. The ends

are cut short and the knot permitted to recede into the scrotum. A drop of collodion upon each puncture completes the operation.

This single ligature suffices for most cases. I also often tie the veins just above and, exceptionally, below the testis, and, in a few cases, I have applied the ligature to dilated veins on the inner as well as on the outer side of the vas. I have never introduced more than three ligatures in any one case. The veins below the testicle are especially hard to separate from that gland.

The only painful part of the operation is the actual ligation of the veins. This may be done under primary chloroform anesthesia or under gas or ethyl chlorid. If the patient is nervous it is, of course, better to employ general anesthesia throughout.

For *after-treatment* the patient is kept in bed with the testicle supported for forty-eight hours. The pain is insignificant and may be soothed by a hot-water bag. A certain amount of edema persists for a month, during which time perfect comfort is insured by a suspensory bandage. After this edema disappears the ligature may be distinctly felt, and usually remains unabsorbed for years. I have found it in place six and seven years after the operation. Rarely the ligature works its way out at the end of several months. This does not incapacitate the patient, since it is accompanied by no active suppuration.

To insure the success of this little operation several points must be insisted upon:

1. Cleanliness, to prevent suppuration.
2. Careful exclusion of the vas deferens from the ligatures.
3. Careful inclusion of all the varicose veins. If all are not included the varicocele may not be cured, or a vein may be punctured.
4. Tying the first knot tightly. If the first knot is not tied with all the surgeon's strength he cannot feel assured that all the veins are obliterated. The tying of this first knot causes considerable pain and faintness.
5. The use of very heavy silk.

If precautions 3, 4, and 5 are observed there can be no recurrence so long as nonabsorbable ligatures are employed. With catgut relapse is certain, with silk practically impossible.

The Open Operation.—The open operation for varicocele is calculated to appeal to the general surgeon. Excellent results may be obtained by this method at the cost of a little extra trouble, a little more time in bed, and a little more danger of prolonged suppuration. Yet the ultimate results are quite as good as those obtained by the subcutaneous method, and there is no danger to life in either case.

It is best to make the incision where the scrotum joins the groin, so that the veins are exposed just below the external inguinal ring. By operating in this region the danger of scrotal hematoma is materially

lessened and the veins are encountered above their point of varicosity and tortuosity and can be conveniently handled. The vas, with its accompanying vessels, is separated from the bundle of veins and drawn to one side. The veins are then divided between two ligatures, or else the bundle of veins is drawn up out of the scrotum, an inch or so excised between ligatures, and the ends of the ligatures left long and tied together. By this means the cord is shortened and the testicle hoisted to its proper position alongside of its partner. Oozing is then checked and the wound closed. The operation may be performed under local anesthesia.

Resection of the Scrotum.—This operation is described on p. 931.

The distensible scrotal skin cannot be depended upon to support the testicle so as to cure varicocele, and therefore I see no purpose in reefing the scrotum, except to remove redundant tissue. To elevate the testicle the veins must be shortened.

OPERATIONS FOR THE CURE OF HYDROCELE

Tapping.—This is best performed with the aspirator (using needle No. 2, Dieulafoy). The skin is made tense, and the needle plunged into the anterior part of the tumor, a little below the center. The testicle should be carefully avoided (Fig. 192).

This simple operation will always efface the tumor at once, but in the majority of instances the sac begins to refill in a few days, and

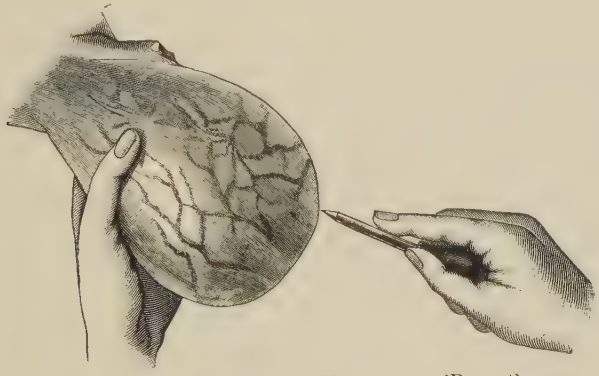

Fig. 192.—Tapping for Hydrocele (Bryant).

after some weeks, or at most months, regains its previous size. Sometimes the tumor never refills, and the palliative operation thus becomes radical. This rarely occurs, except in children.

If the collection of fluid is very large, especially if the patient is old, it is well not to draw it all off at one sitting.

If the testicle is wounded, the patient complains of some pain and the serum withdrawn is bloody. This accident results in immediate refilling of the hydrocele with blood; but no other complication need be feared. If several months elapse before the hydrocele is tapped again, the fluid will usually be found limpid and straw-colored, the blood pigment having been resorbed.

Acupuncture.—This consists in making the skin tense over the tumor, and penetrating the sac rapidly a number of times with a needle, which should be rotated as it is withdrawn. The serum, in cases so operated upon, gradually escapes into the scrotum (in twenty-four to forty-eight hours), where it does no harm, and whence it is absorbed.

Injection.— The only instruments required are an aspirator, a hypodermic syringe and needle, and some pure carbolic acid.[1]

The hypodermic needle, detached from its syringe, is first plunged into the anterior surface of the hydrocele and watched until the appearance of a drop of serum announces that its point is within the cavity. Then the aspirating needle is introduced and the fluid exhausted, *if possible, to the last drop,* since every drop of serum remaining dilutes the acid to be injected. (I have found no advantage from irrigating the cavity with salt solution.)

Meanwhile, the hypodermic needle has not been disturbed. It is now screwed to its syringe, filled with pure carbolic acid, and 0.5 to 1.5 c.c. (5 to 20 minims) of this is injected into the sac. This is smartly rubbed for a moment, and the skin douched with alcohol if any acid has touched it.

The subsequent pain is momentary. The operation, which requires no anesthetic, may be performed in the clinic.

The patient usually prefers to remain in bed for one or two days after the operation, though this is not necessary. For a week or ten days the sac gradually refills. Then it should begin to grow smaller. If it is excessively large at the end of a week, or if marked resorption is not apparent in ten to fourteen days, a secondary aspiration should be performed without injection.

The advantages of injection over any form of incision are manifest if only success may be anticipated. The failures so frequently reported are due to three causes—viz.:

1. Application of injection to cases incurable by this method—i. e.:
   - *a.* Most symptomatic hydroceles.
   - *b.* Spermatoceles.
   - *c.* Hydroceles with inflamed, indurated, or calcareous walls.
   - *d.* Hydroceles containing more than 150 c.c. (5 ounces).
   - *e.* Hematoceles and chyloceles.

[1] I employ the crystals, deliquesced by heat.

2. Errors of technic, notably—
   a. Incomplete evacuation. This is the most frequent cause of failure. To insure success the last drop must be squeezed from the vaginalis.
   b. Injection of the carbolic acid into the cellular tissue. One need scarcely insist upon this point.
   c. Failure to perform the secondary aspiration, which is sometimes part of the cure.

3. The use of iodin instead of carbolic acid. The iodin injection is painful and uncertain, while the carbolic acid, being a local anesthetic, produces only a momentary tingling and, at my hands, has been a certain cure.

Incision (*Volkmann's Operation*).—The sac is incised vertically after the position of the testicle has been ascertained, and its cut edges are sutured to the skin. The surface of the sac is swabbed with pure carbolic acid and drained. The healing of the wound requires an interminable time, and the operation has been dropped in favor of—

Excision (*Bergmann's Operation*).—The skin and fascia are divided down to the surface of the tunica vaginalis and dissected back from it, great care being taken not to injure the sac (Horwitz). The sac is then opened, its contents allowed to drain away and the entire parietal layer snipped off. The visceral layer (the part adherent to the testicle) is swabbed over with pure carbolic acid and the incision closed over a drainage-tube. Complete dissection of the parietal layer is a tedious procedure, and yet recurrence has followed the operation on account of inattention to this detail. A simpler operation, therefore, is

Eversion of the Sac (*Winckelman's Operation*).—The sac is bared and opened as in Bergmann's operation, and all the parietal layer of the vaginalis that can be readily freed is excised. The testicle is then completely extruded from the scrotum, and the tunica, thus turned inside out, is held so by a few sutures passed behind the testis. The cavity of the vaginalis having thus been obliterated beyond peradventure, the testicle is replaced and the wound closed without drainage. Unless traumatic orchitis ensues the cure should be complete within ten days.

Andrews's modification of this procedure consists in making a small incision at the top of the sac and turning the testis out through this, leaving the sac inside out.

Operations for Unusual Hydroceles.—In operating upon infantile hydroceles, bilocular hydroceles, and hydroceles of the cord, each case must be dealt with according to its merits, by resection, inversion, or injection.

EXCISION OF SPERMATOCELE

Though spermatocele may sometimes be cured by aspiration and injection of the sac with carbolic acid, this usually fails. The proper treatment is excision.

The sac is brought out through a longitudinal incision in the scrotum, and, if small, excised entire; if large, it must be incised, its contents evacuated, and its wall carefully removed. If any portion of the cyst wall is permitted to remain, the spermatocele is likely to recur. At the point of implantation of the epididymis, the cyst wall may have to be destroyed by a small point of cauterization.

EPIDIDYMOTOMY

The technic to be followed is that of Hagner. General anesthesia is practically always necessary. I have only once operated without.

At the juncture of the swollen epididymis and testicle, an incision 6 cm. to 10 cm. in length, depending upon the amount of enlargement, is made through the scrotum down to the tunica vaginalis, which is opened at the juncture of the epididymis and testicle. After the serous membrane is opened, all the fluid is evacuated and the enlarged epididymis examined through the wound. The testicle, with its adnexa, is delivered from the tunica vaginalis and enveloped in warm towels. The epididymis is then examined and multiple punctures made through its fibrous covering with a tenotome, especially over those portions where the enlargement and thickening are greatest. The knife is carried deep enough to penetrate the thickened fibrous capsule and enter the infiltrated connective tissue. When the knife is through the thickened covering of the epididymis, a very marked lessening of resistance will be felt. If pus be seen to escape from any of the punctures, the opening is enlarged and a small probe inserted in the direction from which the pus flows. By this method, I believe there is less danger of injuring the tubes of the epididymis than by cutting with the knife. After the probe is passed in, pus will be evacuated by light massage in the region of the abscess, and a fine-pointed syringe is used to wash out the cavity with 1:1,000 bichlorid of mercury, followed by physiological salt solution. The testicle is then restored to its normal position, and in every case the tunica vaginalis is thoroughly washed with 1:1,000 bichlorid, followed by normal salt solution. The incision of the tunica vaginalis is lightly closed with a running catgut suture; a cigarette drain of gauze is then laid over the incision, the skin being brought together with a subcutaneous silver-wire suture, the cigarette drain passing out at the lower angle of the wound (Hagner).

The drain is removed on the second day and the patient kept in bed for from three to five days thereafter. Of course, if the abscess in the epididymis is large, it may be opened by a simple puncture through the adherent skin; but, unless fluctuation can be distinctly felt, it is difficult, by this blind operation, to strike the central suppurating point.

EPIDIDYMO-VASOSTOMY

Anastomosis of the vas deferens to the epididymis is described as follows by its author, Dr. Edward Martin:

Before the operation is undertaken, strictures, posturethral lesions, and chronic inflammation of the seminal vesicles and vas should be cured. The patency of the vas from the epididymis to the prostatic urethra should be assured by an injection into the lumen of the vas of a watery emulsion of inert pigment which, when passed with the urine or expressed by massage of the vasal ampulla, readily may be recognized. This preliminary operation may be accomplished under local anesthesia by means of either an ordinary hypodermic syringe, the needle of which is blunt, or the syringe used by oculists for washing out the lacrymal duct. The vas is held just beneath the skin by the fingers of an assistant; the line of incision is infiltrated; the vas is exposed, slit longitudinally, and from 20 to 30 drops of the injection are driven in. A large injection is likely to occasion severe pain at the base of the bladder (Belfield). If the pigment does not appear either in the urine, in the seminal discharge, or as the result of massage, anastomosis between the vas and epididymis will be futile. . . .

I believe it better to cut the vas obliquely, split it upward for a quarter of an inch and sew this wide-stretched lumen to the opening made, either in the epididymis, or, if spermatozoa are not found there, in the testicle. The microscopist should be at hand who examines the fluid which exudes from the epididymis when it is opened. This opening is made by the pinching up of a very small portion of it in a pair of conjunctival rat-toothed forceps and snipping this portion off by a pair of eye scissors curved on the flat. Usually a little blood and yellowish fluid will exude. This, taken up on a cover glass, will show innumerable spermatozoa. If spermatozoa are not present, other openings must be made into the epididymis or testicle until spermatozoa are found. The anastomosis between the cut ends of the vas and epididymis may be made by means of four sutures carried by fine curved eye-needles. Either silk or fine silver wires answers well. The suture is carried from without into the wall of the vas, and from within out of the wall of the epididymis. The tying down of the sutures completes the anastomosis. The approach to the epididymis and vas is made through the posterior scrotal wall. It usually does not require the application of a single ligature. The veins should be carefully avoided; otherwise troublesome and painful thrombosis will develop.

EPIDIDYMECTOMY

Removal of the tubercular epididymis may be accomplished through an anterior or a posterior incision. The latter is commonly advised, though I prefer the former. The greatest difficulty of the operation is to remove the whole epididymis and all of the actively tubercular tissue without destroying the blood supply to the testicle. This can be accomplished only by bearing constantly in mind the fact that the epididymis lies to the outer side of the vessels.

Unless the tunica vaginalis is occluded by adhesions, the epididymis is approached through this. The incision is carried, if necessary, into the body of the testicle in such a way as to circumscribe all gross tubercular nodules, and though a certain amount of tubercular infiltration is often left in the testicle, this may be disregarded.

The posterior, external, and anterior aspects of the epididymis having been freed both from the testicle and from the surrounding fascia, great care must be taken, in freeing the internal aspect, to keep closely to the tissue of the epididymis itself, especially toward the upper half of the testicle. Even though arteries be divided, the greater part of the vascular structure of the cord may thus be avoided and the viability of the testicle insured. If, however, the remaining fragment of the testicle proves to be of negligible size or of doubtful viability, it had best be removed.

ORCHIDECTOMY

Incision.—If the testicle alone is to be removed, a longitudinal incision in the front of the scrotum suffices; but if, in case of tuberculosis, the vas deferens is to be removed high up, or, in case of neoplasm, the inguinal glands are to be excised, the incision must run up to the groin and over the inguinal canal as far as necessary. In this case the scrotum itself need be incised only for about 3 cm. or 4 cm., since the testicle can be pushed up and out through the inguinal wound.

The Operation.—The testicle is delivered through the incision, freed by blunt dissection from its surrounding fascia and from the base of the scrotum by division of the gubernaculum. The vascular structures of the cord are then separated from the vas, tied and divided.

Treatment of the Vas.—If the vas is not inflamed, it may be tied, divided, touched with the actual cautery, and dropped back into the wound. If tuberculous, the vas is usually best treated by division as high as is compatible with suturing its cut end in the upper angle of the wound, where it is left to suppurate. If it is thought best to remove the whole of the vas, this may be done by opening the inguinal canal, as in the operation for hernia, and freeing the vas well down into the

pelvis, where it may be tied and divided, suppuration from its stub being guarded against by a cigarette drain.

The familiar advice to pull the cord out of the pelvis until it breaks is most reprehensible, since this blind division subjects the patient to the danger of hemorrhage and suppuration, from which latter complication I have known a patient to succumb.

If the seminal vesicle is to be removed with the cord, it is best to open the inguinal canal, free the cord down to the base of the bladder, then put the patient in the lithotomy position, approach the seminal vesicle through the transverse prerectal incision, and, having made the two incisions meet, remove vesicle and cord in one mass.

Excision of Intra-abdominal Glands.—In removing a testicle, the seat of neoplasm, it is wise to remove all palpable inguinal glands (though these do not undergo malignant degeneration unless the skin of the scrotum has been involved), and, opening the inguinal canal, to search along the brim of the pelvis for enlarged iliac glands, which may thus be removed.

THE OPERATION FOR CRYPTORCHIDISM

Incision.—A rather low incision, as for inguinal hernia, is employed. Through this the inguinal canal is opened and the testicle carefully exposed. If there is hernia this is reduced and the sac tied off in the usual manner.

Liberation of the Testicle and Cord.—The tissues of the cord are then dissected free with the minutest care, and this dissection is carried well up into the abdomen, special precaution being taken to separate the cord from all adhesions about the internal abdominal ring, and to carry the dissection beyond the point where the vessels begin to separate from the vas, at the same time using the most minute care not to injure any of these vital structures. During this dissection one always is able to identify the adhesions that have retained the testicle in the groin.

Fixation of the Testicle in the Scrotum.—Having thus freed the structures of the cord to the greatest possible extent, the scrotum is opened up by blunt dissection with the finger and a small incision made in its base. A chromic gut suture is then carried through the fascial covering of the testicle below the epididymis, including, if possible, the rudimentary gubernaculum and avoiding very carefully the epididymis itself. The suture is tied, leaving both ends long, and these ends are carried through the incision at the base of the scrotum. By traction upon this suture, the extent to which the testicle may be drawn down is now estimated, proper allowance being made for the possibility of strangulation if the traction is too forcible.

When the patient is not too young, and the dissection of the cord

has been carefully and fully carried out, the testicle may usually be brought well below the pubic bone, and even to the bottom of the scrotum. A point on the inner surface of the thigh is now selected, corresponding to the incision in the base of the scrotum and opposite the point to which it is judged the testicle may be safely drawn. The integument and superficial fat of the thigh are incised vertically, exposing the fascia lata, and the guiding suture of the testicle is run through this and firmly tied, thereby fixing that organ to the thigh. By three or four points of suture the edges of the scrotal and thigh incisions are now united, after which the inguinal incision is closed as in the operation for hernia, though it is usually impossible to dislocate the cord.

The patient is then incased in a plaster cast from axilla to knee. This cast may usually be retained for seven to ten days, at the end of which time it has served its purpose.

The attachment of the scrotum to the thigh may be maintained for several months, but I can see no advantage in continuing it for more than three weeks. Indeed, if there is much tension, the testicle tends to work loose within this time.

Many other methods of operating for crypt orchidism are employed, but the above method, though it may not always be essential, inasmuch as the testicle may remain in the scrotum without attachment to the thigh, is generally useful, and I always employ it, since any other form of testicular attachment is very likely to fail.

CHAPTER XCI

OPERATIONS UPON THE PENIS

INCISION OF THE FORESKIN FOR CHANCROID

This little operation is performed under infiltration anesthesia, particular care being taken to anesthetize the mucous membrane. A grooved director is then inserted under the foreskin (not in the urethra, if you please), and upon this the skin and mucous membrane are split with scissors from the free margin well back to the corona.

It is better practice to make two such incisions, one on each side of the penis, as recommended by Taylor, rather than to make a single dorsal incision, which does not thoroughly expose the pockets on each side of the frenum.

Do not suture, but protect the incision by 1:5,000 bichlorid wet dressings in the hope of preventing chancroidal inoculation of the wound.

CIRCUMCISION

Anesthesia.—In the infant neither anesthetic nor sutures are essential, although one suture at the frenum is desirable. Older patients require general anesthesia if they are disposed to be nervous; otherwise local anesthesia may be satisfactorily employed. The cocain or alypin is injected in a circle around the penis at the proposed line of incision. The prepuce is then retracted, if possible, and the mucous membrane infiltrated in a circle close about the corona. If the prepuce cannot be retracted, a line of infiltration is made as far as possible within the mucous membrane on its dorsal aspect. This is then split up, the skin retracted, and the circle of infiltration completed.

During infiltration and throughout the operation a band of gauze should be kept tied about the shaft of the penis.

The Operation.—1. Sterilize the parts with soap and water and bichlorid (before infiltration), and, if the prepuce cannot be retracted, irrigate the preputial cavity with 1:5,000 bichlorid solution.

2. Insert a stout probe into the preputial *cul-de-sac,* and with it sweep the entire surface of the glans to detect adhesions, and break them up, if possible.

3. Then catch the prepuce at its muco-cutaneous junction above and below with artery clamps, and draw it forward as far as possible.

4. Now apply the circumcision forceps (Fig. 193). They are to be clamped on the foreskin at an angle of 60 degrees with the long axis of the penis. The point of the forceps should be just behind the lower artery clamp, and great care should be employed not to include any of the glans penis in the grasp of the instrument (Fig. 194).

Fig. 193. — Circumcision Forceps.

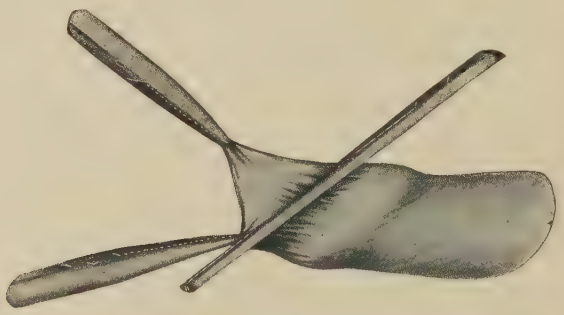

Fig. 194.—Method of Applying Circumcision Forceps.

5. While traction is kept up on the artery clamps, the redundant portion of the prepuce is cut away with scissors curved on the flat.

6. The forceps are now removed, and the skin slips back, exposing a raw surface, the bloody connective tissue overlying the mucous membrane which adheres closely to the glans. This is to be slit down to the corona upon the dorsum, or laterally, and trimmed away on each side up to the frenum, leaving only enough tissue to hold the sutures. Old adhesions may be torn or cut away.

7. Ligatures are rarely necessary. It is preferable to catch bleeding points in the sutures.

8. Rather coarse horsehair has proved the best material with which to suture the cut edges. The first suture should be applied at the raphe, then the others fall naturally in place. They should be applied very close together. Each one should take in the least possible portion of integument on the one side and of mucous membrane on the other. The first knot is to be drawn very tightly to cut into the tissues, the second loosely. The ends of each suture are left long.

9. By means of these long sutures a thick strip of gauze is tied turbanwise about the penis, covering the line of incision. This turban should be very loose (Fig. 195).

10. This dressing is well greased with sterile vaselin, and covered with a loose piece of gauze (to be removed and replaced at each urination), held in place by a loose jockstrap.

After-treatment.—The patient need not be confined to bed more than a day or two, if that long.

The horsehair sutures begin to cut loose within a week. The turban is then cut away; the remaining sutures cut out spontaneously.

Complications.—*Wound infections* after circumcision, notably by tuberculosis and syphilis, have attracted the attention of many authors,

Fig. 195.—Dressing after Circumcision.

and have been illustrated by many curious cases. But, except after ritual circumcision, they are practically unknown nowadays, and present no special features when they do occur. More remarkable is the occurrence of *implantation cysts* which has several times been noticed after this operation.

AMPUTATION OF THE PENIS

The preparation for operation consists in the usual general and local preparation as for any septic procedure. General anesthesia is necessary. With the patient on the table a rubber catheter or tube is clamped about

the root of the penis. Taylor suggests the use of harelip pins to retain it in place. Ample skin-flaps (see below) are then cut and dissected back a full inch, after which the knife is inserted between the corpus spongiosum and the corpora cavernosa, and these bodies separated and amputated, the former being left 2 cm. longer than the latter. The elastic ligature is now removed. This step will be followed by violent hemorrhage, but by the time spurting points have been caught and tied the oozing will be readily controllable by pressure. Hemostasis having been thus effected, the urethra is split into two or more short flaps (see below) and these sutured with fine catgut to the skin. The wound is then dressed aseptically with the stump of the penis erect, and provision made for the passage of the urine, either by a retained catheter, or by sealing the wound with absorbent cotton or gauze applied with iodoform collodion.

If the penis is to be amputated close to the pubes, elastic pressure may have to be dispensed with, and in such cases it is advisable to make a small buttonhole in the perineum, through which the urethra is isolated and sutured to the skin.

Flaps.—A circular skin incision was used by early operators, but flap operations are now in vogue as giving more accurate apposition of the skin edges and cleaner healing. Senn and Jacobson both use long dorsal and short ventral flaps. Jacobson makes his so long that the urethra is sutured to a perforation in its lower part. Others prefer lateral flaps.

The end of the urethra is split in order to avoid a stricture at the new meatus. Ordinarily it is split into two flaps to be sutured to the skin-flaps. Dr. Davis,[1] of Philadelphia, suggests three urethral flaps, each cut to a point and sutured to the skin, divided circularly. Keller [2] advises that the stumps of the corpora cavernosa be sutured together end to end to prevent secondary hemorrhage. It would seem that subsequent erections might tear out these sutures, or at least give rise to considerable pain and tension.

After-treatment.—If the flaps are cut long, erections need not be feared. A light dressing held snugly in place by adhesive plaster should prevent oozing. Frequent change of dressing is necessary to prevent defilement of the wound by urine. The patient should be examined for stricture of the new meatus some weeks after healing is complete.

EXTIRPATION OF THE PENIS

The patient is placed in the lithotomy position, and an elliptical incision is made around the base of the penis. The skin of the scrotum

[1] *Univ. Med. Mag.*, 1896, ix, 264.

[2] *Beitrag zur klin. Chir.*, iv, 235.

is incised along the entire length of the raphe. With the fingers and the handle of the scalpel the halves of the scrotum are then separated down to the corpus spongiosum, a full-sized sound is passed as far as the triangular ligament, and the knife inserted between the corpora cavernosa and the corpus spongiosum. The catheter having been withdrawn, the urethra is cut through just in front of the bulb and detached back to the triangular ligament. The suspensory ligament is then divided and the penis separated from the soft parts down to the attachments of the crura, and each crus separated from the pubic arch by means of a stout periosteal elevator. The edges of the incision in the scrotum are then brought together and the urethra split and stitched to the lower angle of the wound. Drainage is supplied by a tube placed deeply in the wound with its extremities protruding at the upper and lower angles. No catheter need be retained in the urethra. The operation is always protracted, owing to the close and firm attachment of the crura to the bone and the excessive hemorrhage during their detachment. Four arteries—the two arteries of the corpora cavernosa and the two dorsal arteries—must be tied.

TOTAL EMASCULATION

The removal of the testicles adds little to the gravity of extirpation of the penis, and has been strongly urged as an essential part of that operation, on the ground that the testicles "remain ever after sad dumb witnesses of a function which is lost forever" (Montaz), or, in less poetical language, that castration in this case averts the hypochondriacal and maniacal tendency which in late years it has been said to cause when the operation is performed for the relief of prostatic hypertrophy. Pantalini,[1] in particular, argues the case well, confronting the hysterical tendencies of those who have preserved their testicles with the clear-headedness of the emasculated, and the certified strength of mind of Oriental eunuchs. Whether this be generally true or not, it is not amiss to consult the patient's wishes in the matter.

The operation itself is simple enough. The cord, with its vessels and the pampiniform plexus of veins, are tied off by separate ligatures on each side at the external abdominal ring, and cord, vessels, and testicles are removed through the scrotal incision. Pantalini has collected 23 cases without operative mortality, 3 deaths by recurrence within a year, and 1 cure after three years. The remaining 15 were reported cured at shorter intervals.

[1] *Arch. prov. de chir.*, 1898.

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THE END

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